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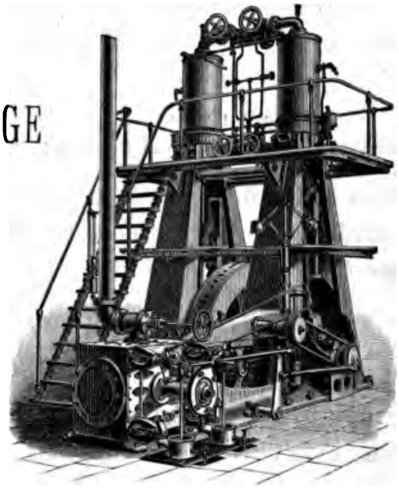
1890

FRICK COMPANY, ENGINEERS.

"ECLIPSE" REFRIGERATING MACHINES

FOR USE IN

COLD STORAGE DEPOTS,
PACKING HOUSES,
BREWERIES,
ICE FACTORIES,
ETC.



RANGING FROM 1 TO 300 TONS CAPACITY.

FULLY WARRANTED.

WE FURNISH PURE ANHYDROUS AMMONIA FOR USE IN OUR MACHINES.

ADDRESS ALL COMMUNICATIONS TO

FRICK COMPANY, ENGINEERS,
WAYNESBORO, FRANKLIN COUNTY, PENNA., U. S. A.

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A FEW POINTERS.

"The desire to buy cheap machinery is a mania with many purchasers."

"To become prejudiced in favor of an article simply because its *first cost is low*, is unfortunate and poor business policy."

"It is shrewd to buy at a fair price ; but to forget that, beyond a certain limit, *cheapness* is to be avoided, is not true economy."

There are several ways to sell cheap :

First. Sell so low you can't live and the sheriff will wind up your affairs, and your creditors carry your losses —*this is dishonest.*

Second. Palm off inferior goods on your customers, and persuade them they are genuine—*this is misrepresentation.*

Third. Employ cheap workmen, buy cheap material, and skin down everything to the last notch—*this is suicidal.*

Fourth. Use best material, best workmanship, understand your business thoroughly, push it with energy, provide special facilities to do *first-class work at the minimum cost,* avoid extravagant management and expensive methods, and deal direct with your customers—*this is straight business.*

"He is a public benefactor that conducts an honest trade, and he is wise who pays the full value of his purchase."

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CHAPTER I.

INTRODUCTION.

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ITEMS OF EXPENDITURES FOR OPERATING PLANTS.

PATENTS.

OUR CHALLENGE.

PURPOSES FOR WHICH REFRIGERATING MACHINES ARE USED.

LIST OF REFERENCES.

QUESTIONS TO ANSWER IN APPLYING FOR AN ESTIMATE.

1890.

FRICK COMPANY, ENGINEERS,

WAYNESBORO, FRANKLIN CO., PA.

U. S. A.

INCORPORATED 1885. ESTABLISHED 1853.

FRICK CO. STEAM ENGINE & BOILER WORKS

ENGINEERING WORKS OF FRICK COMPANY.

JOSEPH PRICE, Prest. SAMUEL HOEFLICH, Vice-Prest.
H. B. STRICKLER, Treas.
EDGAR PENNEY, M. E., Gen'l Supt.
EZRA FRICK, Secretary.

CAPITAL - - - $1,000,000.

INTRODUCTION.

OBJECT OF THIS BOOK.

This pamphlet is published with two objects in view, the first and most important of which is to give intending buyers information in the arts and practices of modern refrigerating engineering ; and the motive that prompts us is a selfish one, inasmuch as we hope to save ourselves in part the task of lengthy answers to letters of inquiry from interested parties asking for detailed or special information which, in the majority of instances, necessitates tedious replies. We may say, further, that it is written in plain every-day language, so the uninitiated can understand it.

WE SOLICIT CORRESPONDENCE.

Do not understand us to mean by the above that we do not desire correspondence. On the contrary, we will be glad to answer all that write to us for information not found herein, and solicit your inquiries.

READ CAREFULLY.

Before writing to us, however, we trust that you will carefully read portions of this pamphlet treating of the special department of refrigeration or ice-making to which you may be directing your attention, and by this means you will be enabled to correspond intelligently and with some prior understanding of the subject-matter of your inquiries. This, of course, applies only to those who have had no opportunity and profess to know but little of the business.

WE HAVE NO SECRETS.

We make no apology to our competitors for explaining what they may be pleased to call the *secrets of the business.*

THE MYSTERIOUS HOCUS POCUS.

Our assistance heretofore has not been enlisted to perpetuate the grand mysterious hocus-pocus methods of some of our contemporaries in this line. *We wish our customers to know* something about this special business, on the ground that the better posted they become the more ready they will be to appreciate and purchase only first-class refrigerating and ice-making machinery, and the less likely they are to buy so-called *cheap* outfits.

ENGRAVINGS.

To assist in this object, we have taken considerable pains to illustrate throughout these pages, by means of drawings and woodcuts made by good engravers, and if intending purchasers wish, we can, in addition, furnish photographs of all machines and special apparatus shown within these covers.

ADVERTISING.

The second object is to advertise our "Eclipse" system of refrigerating and ice-making machinery, and to induce purchasers to buy from us in preference to other builders. This, of course, is understood without saying it in so many words.

AMATEUR ICE MACHINE BUILDERS.

It is true, alas! too true, as many purchasers have learned, that refrigerating and ice-making machinery is made, or rather pretended to be made, by many who are incompetent, but all the same profess to be able to grapple with the problems presented in this peculiar business; and it is quite fashionable for general and jobbing machine-shop owners and engineers, so soon as they learn a little about how a refrigerating machine works, to say, "Pshaw! we can build that as well as any one, and improve upon it," and straightway proceed to put their opinions into practice. Their first idea is that they can build the machinery much simpler and a good deal cheaper than experienced concerns who make a specialty of the business, and who, by dint of perseverance, superior qualifications, abundant capital, facilities, and an organization of trained and skilled assistants that have taken them years to be perfect, have made a success, and who really furnish, at the cheapest possible price, machinery adapted to the needs of their customers.

OF COURSE WE CAN—WHO'S AFRAID?

"O yes," the Simple Simons say, "we can build the machinery, it's simple as A, B, C." And so it is. So is the Corliss Engine, Worthington Pumps, Electric Lights, Locomotives, and a host of other things that but few among the many have successfully manufactured; they forget that only the "fittest survive," and but few make their mark, leaving in the background self-deceived concerns, who lack experience, energy, brains, equipment, and staying qualities.

DEAD FAILURES.

The first idea of most of those who direct their maiden efforts in the line of refrigerating machinery is to find a customer to bear the burden of their experiment. Of course they don't tell him so, he finds that out afterwards.

Within the past six years over forty concerns have attempted to build refrigerating machinery, and but few of the forty are in the business to-day. Ask them and their customers if cheap machinery pays; ask them if good ice-making and refrigerating plants can be made as simple and for as little money they thought it could; ask them if they now have as much confidence in their ability to revolutionize the business as before, and if their embryo machinery filled the bill. The bankrupt courts in many cases answer no, and the novices bewail the day when they attempted a business that required so much of that they did not know of when they started.

DO NOT BE DECEIVED.

Good ice-making machinery cannot be made and sold as cheaply as some suppose, and in buying a plant the customer cannot afford to buy machinery because it is cheap. Neither can we afford to sell low for the sake of making sales, as we expect to continue the business and carry out our guarantees.

BUSINESS IS BUSINESS.

We are in this specialty to stay and serve our customers' best interests. We are here to build only first-class machinery, skillfully designed, of best materials and superior workmanship, and guaranteed by actual performance to be at the head of the line. In purchasing from us we give you the benefit of our experience and the full value of your money, and we would say right here that we are provided with the full equipment and have the experience that enables us to accomplish with the simplest apparatus and secure the best result at the lowest cost, and still make a reasonable profit proportionate to the capital employed.

MISREPRESENTATION.

Misrepresentation is the source of endless trouble to customers, and recoils upon the builder who is injudicious enough to foster this method. None willingly wish to deceive themselves, but some are adept at deceiving others. Call it by any name you wish—"*a skillful way of putting things*," "*keeping real facts in the background*," "*a rose-tinted representation*," "*an ingenious perversion of truth*" —it's all the same. The objective point is to make a customer who does not burden himself with ascertaining the real facts in the case, to firmly believe all that they tell about their own and others' machinery, and take everything for granted without investigation. In this book we strive to post you, that you may not be the victim *of misrepresentation.*

SWEET TALKERS.

That's their name. Look out for them! They tell you that the machinery they represent uses so much less fuel, oil, ammonia, condensing water, that you are led to think it will (almost) run itself. Beware of this fatal idea. *You cannot do something for nothing.* Refrigerating machinery will not run on wind. See cost of running plants, page 166.

and the cost of running a given plant can be calculated with a reasonable degree of certainty.

EFFICIENCY GOVERNED BY INEXORABLE LAWS.

Certain expenditures *have to be made to secure desired results.* The limit of economy has long since been determined by theory and confirmed by practice, hence the least cost is a known quantity. The items are as follows:

FUEL COST

depends largely upon the style and setting of boiler or steam generator employed, kind of fuel and its quality, skill and management of engineer and fireman, proportion of boiler power to work done, rate of combustion, cleanliness of boiler heating and internal surfaces, type of engine, its speed, proportion, workmanship, care taken of apparatus, lubrication, etc.

OIL AND WASTE

depend upon the quality of the lubricant, finish of the machinery, and the man that uses them, and whether the machinery is correctly proportioned to withstand the strains, of good workmanship and materials, and properly fitted with the best automatic oiling devices.

AMMONIA LEAKAGES.

Simply a question of good pipe and fittings, carefully tested apparatus, and permanent character of joints. If these are all present, then it is a question pure and simple of good or bad workmanship and care in erecting; in the case of stuffing box leakages, whether or not you have a good stuffing box construction, or if a single or double acting machine. If you have a double acting machine, don't blame your engineer, if he is a good one, but rather the machine. In our system, the original charge of ammonia should last for years without change, with annual slight addition to same to make up for small losses and deterioration that in the nature of things cannot be wholly prevented in any system.

CONDENSING WATER.

The amount used depends upon the temperature of the water and the amount of cooling work, and in condensers and machines of equal efficiency is about the same. But the construction of machines, the proportion of condensers, and the methods of using water on the same, play an important part. The general arrangement and amount of cooling surface in the condenser is to an expert an index of its economy.

YOU CAN BE DECEIVED

in the performance of refrigerating machinery by many so-called tests or hasty comparison between machines *supposed* to be doing the same kind of work. Some of these prevaricators will select a large machine operating under most favorable conditions (real amount of work done an unknown and guessed at quantity), and tell a customer that they have actually made one ton of ice, or produced one ton of refrigeration, with an impossible amount of water and fuel, and without really knowing any better, guarantee same performance and economy with machines dissimilar in size and to operate under entirely different conditions.

The customer sometimes forgets amid the confusion of their rhetorical display that the larger the machine (providing the work to be done is in proportion to size) the greater the relative economies as measured on the basis per ton of capacity.

OUR CHALLENGE.

We wish it distinctly understood that we build only high grade machinery of the most modern and efficient type, strong, durable, convenient, economical, handsome, and on the interchangeable system, and carry details in stock, and in case of repairs or a break-down we can supply any part by express. We broadly challenge any builder to beat us on a single point. We solicit critical examination and exhaustive tests by competent persons.

PATENTS.

Our system of machinery is protected by a number of valuable patents of our own inventions, and we guarantee absolute indemnity for loss by reason of litigation growing out of alleged infringements.

SPECIAL NOTICE.

For the better protection of our customers, we have secured by purchase and obtained licenses of nearly one hundred patents outside of our own. These include all the foundation patents in general use in the leading Refrigerating and Ice Machine business.

This careful selection of patents enables us to further make good our claim to fully protect our customers and furnish them with the best apparatus that can be made.

PURPOSES

FOR WHICH THE "ECLIPSE" REFRIGERATING MACHINERY CAN BE ECONOMICALLY USED.

IN BEER BREWERIES.

For doing away with the use of natural ice, for every purpose whatsoever—supplying cold water or brine for the Baudelot Cooler, for cooling the beer wort; also to regulate fermentation in the fermenting tubs by means of swimmers or attemporators.

To furnish a constant and easily regulated low temperature in all cellars, storage rooms and apartments. NOTE, THE AIR SUPPLIED IS A DRY, FRESH AND PURE COLD AIR. It does away with slop, rotting of timbers, foul air, dampness and mould, the expense of handling ice, and INCREASES THE CAPACITY OF YOUR BREWERY LARGELY, as you will not need your present ice-house, which you can arrange with floors for storage. The cost of cooling a brewery by our system of Mechanical Refrigeration ranges from one-fifth to one-third of the cost of natural ice, depending upon locality, cost of fuel, etc. See chapter on Brewery Refrigeration.

COLD STORAGE, MARKETS, GROCERIES, ETC.

For the storing in warehouses of many products which may be purchased in low or glutted markets and held for better prices (or stored for the season); TO FURNISH A PURE, SWEET, COLD AIR for the preservation for any length of time of meats, fish, poultry, milk, lard, butter, eggs, vegetables, fruits of any kind, nuts, preserves, foreign and tropical fruits and products, wines, beers, and, in fact, any perishable article of commerce. This is a remunerative field, and many Cold Storage Depots are now successfully established in profitable operation. See pages on Cold Storage.

Packing Houses, Slaughter Houses or Abbatoirs, Curing of Fish, Preservation of Meats, etc.

To abstract the animal heat of carcasses and prepare for market, to preserve for an indefinite period, for storing and curing, transporting long distances, for making ice, etc., etc. See pages on Packing-House Refrigeration.

OCEAN VESSELS, TRANSPORTS, STEAMBOATS, ETC.

Used for preservation of perishable products, and for cooling and ventilating apartments, making ice, etc.

Chemical Works, Dynamite Factories, Paint Works, Vinegar, Sugar, Chocolate, Molasses, Glue Factories, etc.

For hardening or retarding process, for tempering to prevent fermentation, solidifying to facilitate handling, abstracting heat, preserving, etc.

SKATING RINKS, THEATRES, HOTELS, HOSPITALS, PUBLIC BUILDINGS, ETC.

For making artificial skating floors, ventilation and cooling store rooms, for cooling water, making ice, cooling wards, etc.

LARD, PARAFFINE AND OIL MANUFACTURERS.

For congealing and hardening or facilitating processes of manufacturing and storage.

MANUFACTURE OF ICE, DISTILLERS, WINE STORAGE, ETC.

The Eclipse Refrigerating Machine is one of the most successful ice-making machines in use. We can produce with a single machine 100 tons of clear crystal ice every 24 hours. See pages 38 to 44.

In fact, the field for the successful and economical use of mechanical refrigerating machines is an expansive one, and we are often surprised ourselves TO FIND SO MANY NEW AND REMUNERATIVE ADAPTATIONS FOR OUR SYSTEM.

We will be pleased to answer all questions to the advantage of parties desiring information. We refer you to our list of questions found on page 22.

REFERENCES FOR OUR ECLIPSE REFRIGERATING MACHINERY.

Below we publish a partial list of parties who have our improved Refrigerating and Ice-making Machinery in use. Please to ask them what they think of it, and learn for yourself if they support our claim that we build the best.

BREWERIES.

Parkersburg Brewing Co., Parkersburg, W. Va.,	27	ton	Refrigerating	capacity.
Bellevue Brewing Co., Cincinnati, Ohio,	50	"	"	"
Cumberland Brewing Co., Cumberland, Md.,	27	"	"	"
Phoenix Brewing Co., Baltimore, Md.,	27	"	"	"
Gipps Brewing Co., Peoria, Ill.,	50	"	"	"
Sprattler & Mennell, Paterson, N. J.,	32	"	"	"
Herman Lackman, Cincinnati, O.,	65	"	"	"
Henry Fink, Harrisburg, Pa.,	32	"	"	"
Sebastian Helldorfer, Baltimore, Md.,	32	"	"	"
Frank Reisch & Bro., Springfield, Ill.,	50	"	"	"
Jos. Stein & Co., Louisville, Ky.,	23	"	"	"
Meyer & Reidlin, Covington, Ky.,	32	"	"	"

PACKING AND COLD STORAGE.

J. C. Shafer & Co., Baltimore, Md.,	40	ton	Refrigerating	capacity.
G. Cassard & Sons, Baltimore, Md.,	25	"	"	"
Baltimore City Storage Co., Baltimore, Md.,	32	"	"	"
Armour Packing Co., Kansas City, Mo.,	100	"	"	"
Shallcross & Son, Coatesville, Pa.,	15	"	"	"
Washington Market Co., Washington, D. C.,	32	"	"	"
Armour Packing Co., Kansas City., Mo., 2d order,	150	"	"	"
Francis Whittaker & Sons, Wichita, Kan.,	150	"	"	"
Emil Winters, Pittsburg, Pa.,	37	"	"	"
Frank Seifried, Louisville, Ky.,	7	"	"	"
Chicago Pack'g & Provis'n Co., Chicago, Ill.,	150	"	"	"
" " " " " " 2d order,	150	"	"	"
Steelton Store Co., Steelton, Pa.,	10	"	"	"
Pittsburg Meat Supply Co., Allegheny, Pa.,	50	"	"	"
J. Vogle & Sons, Cincinnati, Ohio,	50	"	"	"
John C. Hately, Chicago, Ill.,	65	"	"	"
George Hammond & Co., Chicago, Ill., 2d order,	150	"	"	"
Calumet Canning Co., Hammond, Ind.,	32	"	"	"
West Chester Cold Storage Co., West Chester, Pa.,	10	"	"	"

ICE FACTORIES.

F. L. Ellis & Co., Hopkinsville, Ky.,	10	ton	Ice	Capacity.	Can	system.
Consumers Ice Co., New Orleans, La.,	100	"	"	"	Smith plate	"
Little Rock Ice Co., Little Rock, Ark.,	35	"	"	"	Can	"
Owensboro Ice Mfg. and Cold Storage Co., Owensboro, Ky.,	20	"	"	"	Smith plate	"
Wm. S. Lurton, Jacksonville, Ill.,	15	"	"	"	Can	"
Pulaski Ice Co., Pulaski, Tenn.,	5	"	"	"	"	"
Armour Packing Co., Kansas City, Mo.,	75	"	"	"	"	"
Ewing & Beall, Uniontown, Pa.,	15	"	"	"	"	"
S. W. Hill, Allegheny, Pa.,	20	"	"	"	"	"
Chautauqua Lake Ice Co., Pittsburg, Pa.,	40	"	"	"	"	"
" " " " 2d order,	40	"	"	"	"	"
Westchester Ice and Cold Storage Co., Westchester, Pa.,	5	"	"	"	"	"
Cumberland Brewing Co., Cumberland, Md.	8	"	"	"	"	"
Steelton Store Co., Steelton, Pa.,	2	"	"	"	"	"
Parkersburg Brewing Co., Parkersburg, W. Va.,	3	"	"	"	"	"
Hagerstown Ice Co., Hagerstown, Md.,	20	"	"	"	"	"
Alberto Malo, City of Mexico, Mexico,	25	"	"	"	"	"

Other Machines in course of erection.

COST OF COMPLETE PLANT FOR REFRIGERATING AND ICE MAKING.

We would thank all applicants for prices to answer the following questions, as a careful attention to this may be sufficient in the majority of cases to give you a close approximation to the cost of plant you require.

To FRICK COMPANY, ENGINEERS,
WAYNESBORO, FRANKLIN COUNTY, PA.

(Please give full and complete answers to all questions that relate to your business.)

1. Kind of business.
2. Where located.
3. Firm name.
4. References.
5. Have you ever used Refrigerating Machinery?
6. Where made and what capacity?
7. Have you an ample supply of water for use in the condenser of machine, counting three gallons per minute for each ton ice, or one gallon for each ton refrigerating power.
8. How many gallons per minute?
9. Temperature of the water in midsummer.
10. Source of supply.
11. Can you get additional supply of water, if needed?
12. If for ice-making, how many tons ice do you wish to make per day or twenty-four hours?
13. Quality of water you intend to use in ice-freezing cans and where obtained.
14. Kind of fuel you intend to use.
15. Cost of fuel per ton or cord.
16. How large do you wish the cakes of ice?
17. Name the lowest temperature you require in your rooms.
18. Give the size of the rooms (each of them) by giving the exact height, length and width. If arch vaults, give spring of arch.
19. In packing and slaughter houses, give tons of fresh meat daily handled, or kind and number of carcasses.
20. If for a brewery, give barrels of beer brewed per day.
21. Capacity of storage and rooms in cubic feet.
22. If you wish to use attemporators in fermenting tubs.
23. Barrels per brewing.
24. Brewings per day.
25. Do you think of extending your building and business?
26. If for any other purpose than that to which the questions above apply, you will please state plainly the object, the present treatment, and results desired to be obtained, the quantity of material and its nature, and any information that may be useful.
27. **In all cases do not fail to send us a sketch or drawing of your build- [illegible] g dimensions, and indicating on the sketch where you [illegible]ate the machinery.**

CHAPTER II.

MECHANICAL PRODUCTION OF COLD.

COMPARISON OF DIFFERENT SYSTEMS.

THE REASONS WHY AND WHEREFORE.

ILLUSTRATIONS OF METHODS EMPLOYED.

READ THIS CAREFULLY, AS IT IS THE FOUNDATION UPON WHICH YOU ARE TO BUILD YOUR UNDERSTANDING OF THE BUSINESS AND APPRECIATE WHAT IS TO FOLLOW.

THEORY AND PRACTICE OF MECHANICAL PRODUCTION OF COLD,

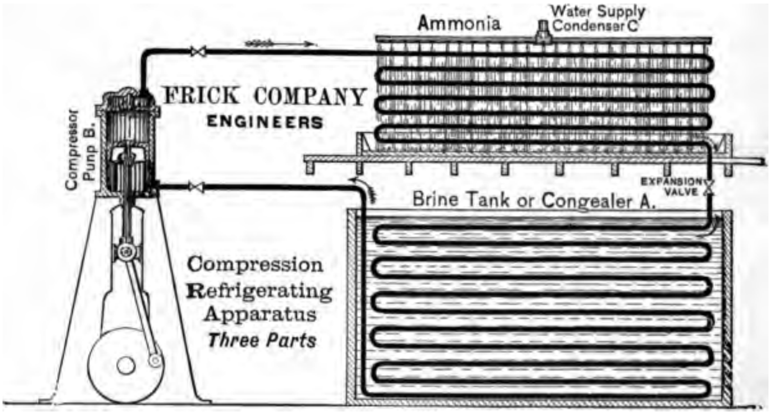
OR, WHY A REFRIGERATING MACHINE DOES ITS WORK.

About the first thing asked by persons who are becoming interested in the subject of Refrigerating or Ice-making, who are anxious to know how the thing is done, is, Will you tell me how you produce such an intense degree of cold by machinery?

As this has been asked time and again, we will here beg to save time by briefly reviewing the principal features, and essay to do so in such a way that those who claim no particular knowledge of physics and thermodynamics may follow the text and become somewhat conversant with the subject.

MECHANICAL REFRIGERATION,

primarily, is produced by the evaporation of a volatile liquid which will vaporize at low temperatures, and by means of our special apparatus the intensity and desired amount of refrigeration is under control of the operator.



OUTLINE DRAWING OF MECHANICAL COMPRESSION SYSTEM.

APPARATUS.

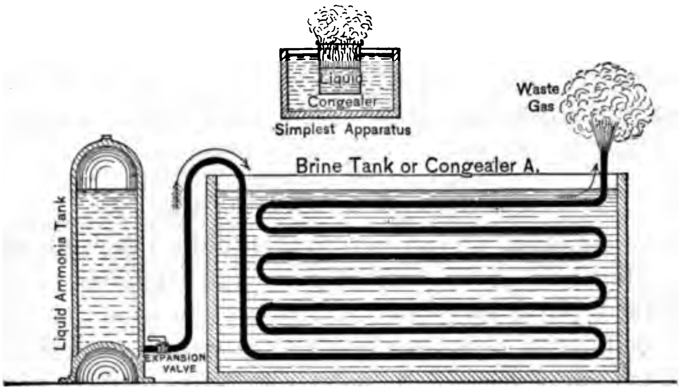
The simplest form of apparatus employed consists of three principal parts: *A*. An "evaporator," or, as sometimes called, a "congealer," in which the volatile liquid is vaporized. *B.* A combined suction and compressor pump, which sucks or, properly speaking, "aspirates" the gas or vapor from the evaporator as fast as formed. *C.* A liquefier or, as commonly called, "condenser," into which the gas is discharged by the compressor pump, and under the combined action of the pump pressure and cold condenser the vapor is here reconverted into a liquid, to be again used in the congealer.

THE VOLATILE LIQUID WE EMPLOY.

Refined anhydrous ammonia liquid, from which every impurity has been eliminated, is the cold-producing agent used by us. "Anhydrous" means free from water, but there are many other things to be rejected before a pure liquid can be obtained. See chapter on Ammonia.

FUNCTION OF THE PUMP AND CONDENSER.

The office of the compressor pump and condenser is to reconvert the gas after evaporation into a liquid and make the original charge of ammonia available for use in the same apparatus over and over again.



Elemental Refrigerating Apparatus.

Two Parts

SIMPLEST FORM OF REFRIGERATION MACHINE (ILLUSTRATIVE).

It will appear to the reader, after having carefully followed our text, that the pump and condenser might be dispensed with, but these conditions may only be economically realized when the at present expensive ammonia liquid can be obtained in great quantity and at less cost than the process of reconverting the vapor into a liquid by compressing machinery and condenser on the spot.

WHAT DOES THE WORK.

The real index of the amount of cooling work possible is the number of pounds of ammonia evaporated between the observed range of temperature.

To make the above clear, we will add that each pound of ammonia during evaporation is capable of storing up a certain quantity of heat, and that the simplest forms of refrigerating apparatus might consist, as shown by engraving, of two parts, to wit, a *congealer* and a *tank* of ammonia. In this apparatus the ammonia is allowed to escape from the tank into the congealer as fast as the *coils therein are capable of evaporating the liquid into a gas;* when completely expanded, the resulting vapor is allowed to escape into the atmosphere, which means *it is wasted*, the supply being maintained by furnishing fresh tanks of ammonia as fast as contents are exhausted. This process, while simple, would be tremendously expensive, costing at the rate of about $250 per ton refrigerating or ice-melting capacity. To recover this gas and reconvert to a liquid on the spot in a comparatively inexpensive manner, you now see, is the function of the compressor pumps and condensers.

PRINCIPLES OF OPERATION.

The action of all refrigerating machines depends upon well defined natural laws that govern in all cases, no matter what type of apparatus or machine is used; the principle being the same in all, while processes may slightly vary, the properties of the particular agent and manner of its use affecting, of course, the efficiency or economic results obtained.

PROPERTIES OF AMMONIA.

As we use anhydrous ammonia, we will confine our remarks strictly to this agent, stating, however, that it is only one of many substances that can be used; but none so far experimented with have proved so well adapted to our purpose. See chapter on Ammonia.

LATENT HEAT OF EVAPORATION.

As previously intimated, a liquid passing into a gaseous state, or when converted into a vapor, carries away a definite amount of heat from objects by which it is surrounded, and its capacity for storing heat under these conditions is called its *latent heat of evaporation.*

UNIT OR MEASURE OF HEAT.

The unit employed to measure the amount is called a *thermal unit,* and refers to an equivalent of one pound of water raised or lowered one degree Fahrenheit.

NEGATIVE AND POSITIVE HEAT.

For convenience we call the work done in cooling *negative heat,* in contradistinction to heating or *positive heat.* The same laws apply to both.

NEGATIVE HEAT IN ICE.

One pound of ice in melting requires the application of 142 units of heat, and in round numbers the evaporation of one pound of liquid ammonia *is equivalent to the cooling* work done by the melting of *four pounds of ice into water at* 32°.

BOILING POINT OF AMMONIA.

Ammonia will boil or evaporate when exposed to the atmosphere at a temperature of 28½° Fah. below zero, or 240½° lower than boiling point of water under same conditions.

A HOT SNOW BANK.

It should now appear plain to you that a vessel of liquid ammonia thrust into a snow bank at 32° (which is 60½° above its boiling point) would bear about the same relation to the snow bank as a vessel of water thrust into a fire. In both these cases there would be an evaporation of the liquids and absorption of heat by the resulting vapor. To make this appear as plainly as possible, we say further, that the heat to evaporate the ammonia is robbed from the snow bank, which is made even colder than before.

WATER WOULD FREEZE.

Water similarly thrust into a snow bank *would scarcely evaporate, because the temperature of snow is far below its boiling point*. Ammonia *would evaporate* in the snow bank *because its temperature is above the boiling point* of the pure anhydrous liquid.

RELATIONS OF HEAT.

The popular idea of heat is that it should be *hot enough to burn,* and it is difficult for most persons to form any other conception.

ABSOLUTE ZERO.

When we state for your information that the absolute or real zero of the negative scale is 461° below the zero of the thermometers, you will comprehend that within this great range it is more a question of *the relative difference of temperature* between two bodies brought in contact, that determines the amount of heat that is lost by the one and gained by the other, *than the exact position in degrees they occupy upon the thermometric scale.* The hottest will invariably impart its heat to the coldest until temperatures are equalized, and in the case of the ammonia whose boiling point is 28½° below our zero, it will continue to boil at atmospheric pressure and carry off heat so long as it is in contact with any substance hotter than itself, or above 28½° below zero, making that substance continually cooler by absorbing its heat, or at least until it has been reduced to a temperature corresponding to the pressure under which the ammonia gas is formed; this point reached, the ammonia will cease to evaporate and remains in a liquid state.

LIQUEFACTION OF GASES.

All the so-called permanent gases, such as hydrogen, nitrogen and others, including the compound air itself, are simply the vapors or combination of vapors or gases of some liquid whose boiling points are so low upon the thermometric scale *that the heat of the earth is sufficient to maintain them in the gaseous state,* and at no time so low that they will be condensed and restored to their liquid state. It is simply necessary to call attention to the numerous experiments made by prominent physicists who have proved this theory, by subjecting all known gases to artificial cold and pressure and condensing them to a liquid. This is the method in common use for liquefying gases, that is, to subject them to constant pressure, and while in this state to rob them of their latent heat of vaporization, by allowing cold water to flow over the apparatus, or in case of the more permanent gases, at the same time subjecting them while in the condenser to most intense artificial cold that can be produced and thus liquefying them. Ammonia gas by the combined effect of constant compression or pressure, and flowing water on the liquefier having a temperature slightly lower than the boiling point of liquid at the given pressure, is easily liquefied in any desired quantity.

THE REASON GAS LIQUEFIES.

This may not seem plain at first sight, but we will try and explain the reason. For instance: It is well known that increasing the pressure upon a liquid raises its boiling point, and from this fact you can guess that liquid ammonia, which we stated would boil at 28½° under the pressure of one atmosphere, *would have its boiling point raised in proportion to the pressure to which it is subjected,* and you can readily see that this can be carried to such an extent that the boiling point of ammonia can be thus *mechanically raised to any temperature desired.* You can further understand that gas at a given pressure must have a temperature or boiling point to correspond. For instance, the boiling point of water at 15 pounds absolute (the atmospheric pressure) is 212°, and the temperature of its gas or steam is likewise 212°.

RELATION OF PRESSURE AND TEMPERATURE.

Pressure and temperature are interrelated. That is to say, at a certain pressure saturated gas has a corresponding temperature, and this is also the case with ammonia. See table, page 209. Hence, if the gas, while subjected to a certain uniform pressure or *artificial atmosphere*, be discharged into an air-tight vessel which is being constantly cooled by water of a somewhat *lower temperature than that due to the pressure of the gas*, the vapor will necessarily under these conditions collapse and be condensed inside the vessel and go back to the liquid form.

ACTION OF CONDENSER.

The temperature of the water available for use on the vessel (condenser) determines the pressure to which the gas must be subjected in order *to raise its boiling point or artificial atmosphere high enough so it cannot exist as vapor when chilled by contact with condensing surfaces slightly colder than itself, but will collapse.* The condenser is an interesting application of a natural law made clear by investigating the relations of boiling points and pressures.

REMARKS.

With this introduction to our subject, we have to say that in our mechanical compression refrigerating apparatus we have taken advantage of and successfully applied these known laws of nature, the operation of the machinery in brief being as follows:

OPERATION OF COMBINED APPARATUS.

See Engraving, page 24.

The apparatus being charged with a sufficient quantity of pure ammonia liquid, which we will for simplicity assume to be stored in the lower part of the condenser *C*, a small cock or expansion valve controlling a pipe leading to the congealer or brine tank *A* is slightly opened, thus allowing the liquid to pass into the evaporator coils. *These coils, by the way, really perform the same office as a tube or flue in steam boilers, and have precisely the same function,* and may be called *heating or steam-making surface.* The amount of water capable of being boiled into steam in a boiler depends upon the square feet of heating surface, temperature of fire and pressure of steam, and the same is true of the capacity of heating surface presented by the coils in the evaporator. *The heat is transmitted through the coils from surrounding substance to the ammonia liquid,* which is boiled into a vapor the same as water is boiled into steam in a steam boiler; as previously explained, the surrounding substances part with an equivalent amount of heat and thus become cooler, the amount taken up and made negative being in proportion to the pounds of liquid ammonia evaporated.

MECHANICAL COLD EASILY REGULATED.

This being under control of the cocks or valve leading from the condenser (called an expansion valve). As the gas begins to form in the evaporator, the compressor pump *B* is set in motion at such a speed as to carry away the gas as fast as formed, which is discharged into the condenser under such pressure as will bring about a condensation and restore the gas to the liquid state, the operation being continuous so long as the machinery is kept in motion.

UTILIZING THE COLD.

To utilize the cold thus produced for refrigerating, two methods are in use, the first of which is called the BRINE SYSTEM, the second is known in the trade as the DIRECT EXPANSION SYSTEM, both of which we will now proceed to explain at some length.

BRINE SYSTEM.

In this method the ammonia-evaporating coils are placed in a tank which is filled with strong brine made of common salt, which is well known not to freeze at temperatures as low as zero.

This is the Brine Tank or Congealer *A*. The evaporating or expansion of the ammonia in these coils robs the brine of heat, as heretofore explained, the process of storing cold in the brine going on continuously and being regulated as required at the gas-expansion valve.

To practically apply the cold thus manufactured, the chilled brine or non-freezing liquid is circulated by means of a pump through coils of pipe, which are placed on the ceiling or sides of the apartments to be refrigerated, the process being analogous to heating rooms by steam.

THE BRINE COOLS THE ROOMS.

The cold brine in its circuit along the pipes becomes warmer by reason of taking up the heat of the rooms, and is finally returned to the brine tank, where it is again cooled by the ammonia coils, the operation, of course, being a continuous one.

DIRECT EXPANSION SYSTEM.

In this scheme the expansion or evaporating coils are not put in brine tanks, but are placed directly in the rooms to be refrigerated, and the ammonia is evaporated in the coils by coming in direct contact with the air in the room to be refrigerated, no evaporating tank being used.

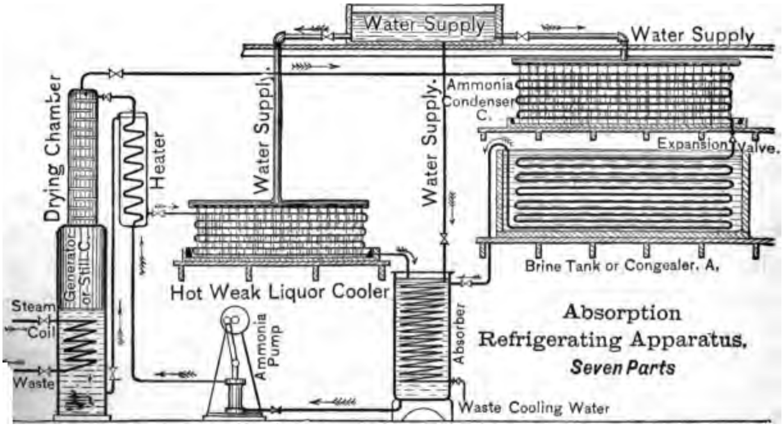
A BRINE PLANT CONSISTS OF

1. Compressor Pump; 2. Condenser; 3. Brine Tank; 4. Pump and Circulating Piping in the rooms.

A DIRECT EXPANSION PLANT CONSISTS OF

1. Compressor Pump; 2. Condenser; 3. Pipes for expansion of ammonia in the rooms; 4. A complicated system for distributing and regulating evaporation in the various rooms.

ABSORPTION SYSTEM.



Absorption Refrigerating Apparatus.
Seven Parts

ABSORPTION SYSTEM APPARATUS CONSISTS OF

1. *Generator* or still with coils.
2. *Analyzer* or drying chamber with baffle trays.
3. *Exchanger* or heater with coils.
4. *Ammonia condenser* with drips.
5. *Cooler* for weak liquor with coils.
6. *Absorber* with coils.
7. *Ammonia pump.*
8. *Receiver* for ammonia.
9. *Brine tank* or congealer.

And they still call it simple.

See page 110 for details and history of the Absorption System.

COMPARATIVE MERITS OF THE BRINE AND DIRECT SYSTEMS.

For a discussion of the comparative merits of the Brine and Direct Systems, we invite your attention to page 88, and for a minute description of the various details to the chapters specially treating of the same.

RATING OF MACHINE IN TONS CAPACITY.

For the information of the unskilled reader we would state that machines are susceptible of two ratings—that is, either their capacity is given in *tons of ice they will produce* in one day (24 hours), called ICE-MAKING CAPACITY, or they are rated equal to the *cooling work* done by one ton of ice in melting per day (24 hours), called REFRIGERATING CAPACITY.

DIFFERENCE IN THESE RATINGS.

Ordinarily the *ice-making capacity* is taken at about one-half of the *refrigerating capacity;* but this is only approximate, and the tons of ice a refrigerating machine will make depends upon the initial temperature of the water to be frozen.

UNIT OF CAPACITY.

The unit of capacity is one ton of ice made from water at 32° Fah. into ice at 32° per day, which is equal to 284,000 pounds of water cooled one degree or 284,000 heat units, and is the tonnage basis for refrigerating capacity as well as ice capacity when ice is made from water at 32°.

REAL ICE-MAKING CAPACITY.

Depends upon the temperature of the water to be frozen and can be calculated as follows: One pound of ice in melting into water at 32° will take up 142 positive units of heat, and hence it follows that water at 32° will require 142 negative heat units to make it into ice. If the water to be frozen is taken from the usual source of supply—for instance, a pond or river—its temperature in midsummer may rise as high as 82°. This must first be cooled to 32° before freezing commences, hence $82^\circ - 32^\circ = 50^\circ + 142^\circ = 192^\circ$ heat units per pound of water frozen. Manufactured ice is generally far below 32°, because the temperature of the bath in which it is made ranges about 20° degrees below the freezing point, and this work is to be added also. Taking into calculation the specific heat of ice, this extra negative heat would equal approximately 10 units, which added to $192^\circ = 202^\circ$, hence $\frac{142 \times 100}{202} = 60\frac{8}{10}$ per cent tons of ice made per ton refrigerating capacity. This is approximate and does not take into account other items, such as losses by ice tank and can exposure, wastage in thawing out of moulds, etc.

CHAPTER III.

TABLES OF SIZES OF OUR ECLIPSE REFRIGERATING AND ICE MACHINES AND PARTICULARS.

ENGRAVINGS AND DRAWINGS OF GAS COMPRESSERS.

SECTIONAL DRAWINGS OF MACHINES AND ENGRAVINGS OF ALL SIZES, FROM 5 TO 150 TONS CAPACITY.

INDICATOR DIAGRAMS FROM PUMPS AND ENGINES.

DESCRIPTION OF MACHINE AND DETAILS.

COMPARISON OF SINGLE AND DOUBLE ACTING PUMP.

ACCIDENT TO PUMPS USING SUCTION-VALVE THAT WILL DROP INTO THE CYLINDER.

PLAN OF FRICK COMPANY'S WORKS.

A PECULIAR BUSINESS.

OVERHUNG FLY-WHEELS AND THEIR DANGER.

INTERESTING READING FOR ALL MEN AND THINGS YOU WANT TO KNOW.

A CAMPAIGN LIE NAILED AND FLUNG BACK TO THE PREVARICATORS.

REFRIGERATING MACHINES.—TABLE OF SIZES FOR WHICH WE HAVE PATTERNS.

TWO SINGLE-ACTING GAS COMPRESSORS.

OUR REGULAR LIST.

Machine Number.	Pumps and Engine—Dimensions.			Revolutions per Minute.	Horse Power of Engine.	*Capacity at Revs.* TONS 24 HOURS.		Floor Space and Total Height.			Horse Power of Boiler Recommended.	Shipping Weight of Machine Alone.	Coal Consumption, Lbs. at Capacity Given. 24 Hours.	Condensing Water per Minute, Gallons.
	Gas Pumps, Sizes.	Steam Engine, Sizes.	Type of Engine.			Ice-Making, Maximum Allowed.	REFRIGERATING.	Length.	Width.	Height from Floor to Top of Machine.				
	Inches.	Inches.						Feet.	Feet.	Feet.				
1	4 x 8	7 x 8	Slide Valve.	80	5	1	2	9½	9	11½	10	16.000	912	3
2	5½x 8	8½x 8	" "	80	8	2	4	9½	9	11½	15	17,000	1,440	5
3	6 x14	10 x14	" "	75	14	4	7½	11½	10¼	13½	25	26,000	2,160	8
4	7¼x14	11 x14	" "	75	18	6	10½	11½	10¼	13½	30	28.000	2.640	12
5	8½x20	13 x20	Cut Off.	70	28	10	18	15	12½	15½	40	48.000	3.600	20
6	9½x20	15 x20	" "	70	42	15	27	15	12½	15½	60	59.000	5,040	30
7	10½x24	16 x24	Corliss.	65	48	20	32	16¼	12⅔	17½	80	68,000	5,280	35
8	11½x24	17 x24	"	65	60	25	40	16⅔	12⅔	17½	90	70,000	6.020	42
9	12½x28	19 x28	"	60	75	30	50	18¼	13	19	100	82,000	7,200	50
10	13½x28	20 x28	"	60	90	35	60	18½	13	19	120	84,000	8,060	60
11	14 x32	22 x32	"	60	105	40	70	20½	15	21¼	140	105,000	9,360	70
12	15 x32	24 x32	"	60	128	50	85	20½	15	21¼	170	110.000	11,280	85
13	16 x36	26 x36	"	55	150	60	100	24½	16	23½	200	165.000	12,960	100
14	17 x36	28 x36	"	55	165	65	110	24½	16	23½	220	175,000	14,280	110
15	19 x40	30 x40	"	55	195	75	130	27	17	26	270	185,000	16,320	130
16	20 x40	32 x40	"	50	228	90	155	27	17	26¼	300	193,000	19,200	155

SPECIAL SIZES OF REFRIGERATING AND ICE-MAKING MACHINES, for which we have patterns and make only to accommodate our customers. (Each of these machines we have built.) *Notice.*—The special sizes being out of the regular line, come at a higher price.

A	8½x16	14 x16	Cut Off.
B	10½x16	16 x16	" "
C	10½x20	16 x20	" "
D	10½x28	16 x28	" "
E	12½x24	19 x24	Corliss.
F	12½x32	19 x32	"
G	20 x36	30 x36	"

Particulars of these machines on application.

Machines adapted for driving by separate Engine or Water Power when required.

NOTE.—Coal and water consumption given in above table are for the capacities given, at 15 pounds expansion and 180 pounds condensing gas pressure.

Increase of speed means increase of capacity. See table of Ice Machines for selecting same.

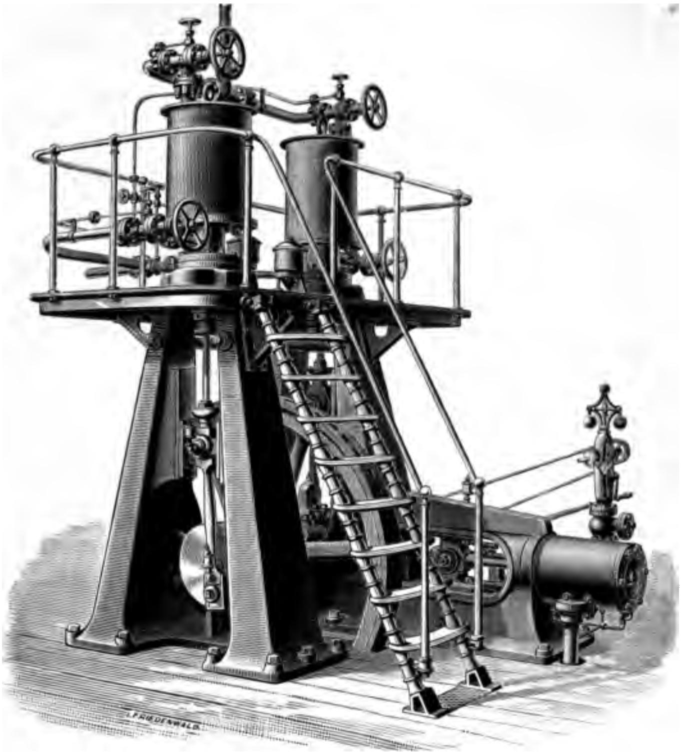
ICE MAKING MACHINES.—TABLE OF SIZES FOR WHICH WE HAVE PATTERNS.

OUR REGULAR LIST.

Number of Machine.	Pump and Engine Dimensions.			Revolutions per Minute.	Horse Power of Engine.	CAPACITY.	Floor Space and Total Height.			Shipping Weight Machine Alone.	Horse Power of Boilers Necessary to Produce Distilled Water.	Pounds of Coal Required 24 Hours Full Capacity to produce Distilled Water.	Water for All Purposes, Gallons per Minute.
	Gas Pumps, Sizes.	Steam Engine, Sizes.	Type of Engine.			*Suitable for Ice Factories.* TONS CAPACITY 24 HOURS.	Length.	Width.	Height from Floor to Top of Machine.				
	Inches.	Inches.					Feet.	Feet.	Feet.	Pounds.	H. P.		
1	4 x 8	7 x 8	Slide valve.	80	6	½ to 1	9′ 6″	9′ 0″	11′ 6″	16,000	10	900	10
2	5½x 8	8½x 8	" "	80	10	1 " 2	9 6	9 0	11 6	18,125	20	1,500	10
3	6 x14	10 x14	" "	75	15	2 " 3	11 6	10 3	13 6	26.500	35	1,800	15
4	7¼x14	11 x14	" "	75	20	4 " 5	11 6	10 3	13 6	27.727	45	2,500	22
5	8½x20	13 x20	" "	70	30	7½ " 10	14 10	12 6	15 4	48,000	60	3,600	40
6	9½x20	15 x20	" "	70	45	12½ " 15	14 11	12 6	15 5	59.438	80	5,000	60
7	10½x24	16 x24	Corliss.	65	50	15 " 20	16 6	12 7	17 4	68,397	90	6.000	80
8	11½x24	17 x24	"	65	65	20 " 25	16 8	12 8	17 6	71,200	125	7,500	100
9	12½x28	19 x28	"	60	80	25 " 30	18 2	12 8	18 10	82,482	140	9.000	120
10	13½x28	20 x28	"	60	95	30 " 35	18 4	12 9	18 10	84,320	160	10,500	140
11	14 x32	22 x32	"	60	110	35 " 40	20 4	14 10	20 3	104,896	180	12,000	160
12	15 x32	24 x32	"	60	135	45 " 50	20 6	14 10	21 4	110,040	200	15,000	200
13	16 x36	26 x36	"	55	160	55 " 60	24 6	15 9	23 7	165.000	250	18,000	240
14	17 x36	28 x36	"	55	175	60 " 65	24 6	15 9	23 7	174,900	275	19,500	260
15	19 x40	30 x40	"	50	205	70 " 75	26 10	17 0	26 1	185,100	300	22,500	300
16	20 x40	32 x40	"	50	235	80 " 90	27 0	17 0	26 2	193,250	375	27,000	360

NOTE.—***The Steam Boilers in an Ice Factory must be large enough to supply distilled water.*** **This makes them larger than actually required to drive machines, hence more fuel is required than in refrigerating plants using equal capacity of machine.**

For the Smith Plate Ice System use same size Boilers as named in table of Refrigerating Machines, at their rating in ice capacity.

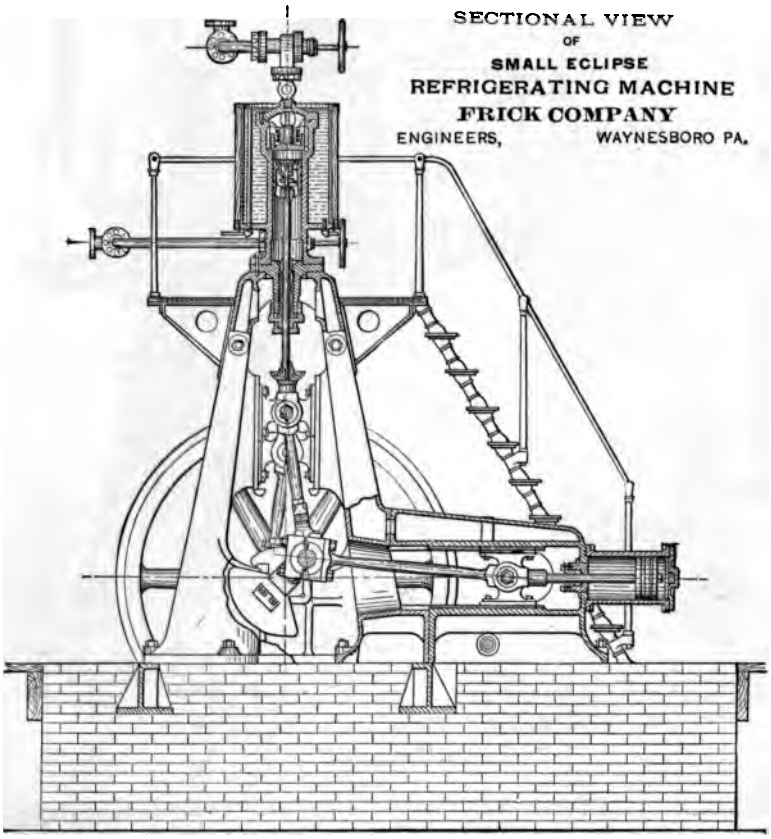


(PATENTED.)

SMALLEST SIZE ECLIPSE REFRIGERATING MACHINE.

The above engraving is from a photograph of our smallest patterns, with Tremper cut-off governor. It will be seen that the same general design has been adopted in this size as in the larger machines, making it one of the most compact, substantial, economical and easily managed ever introduced.

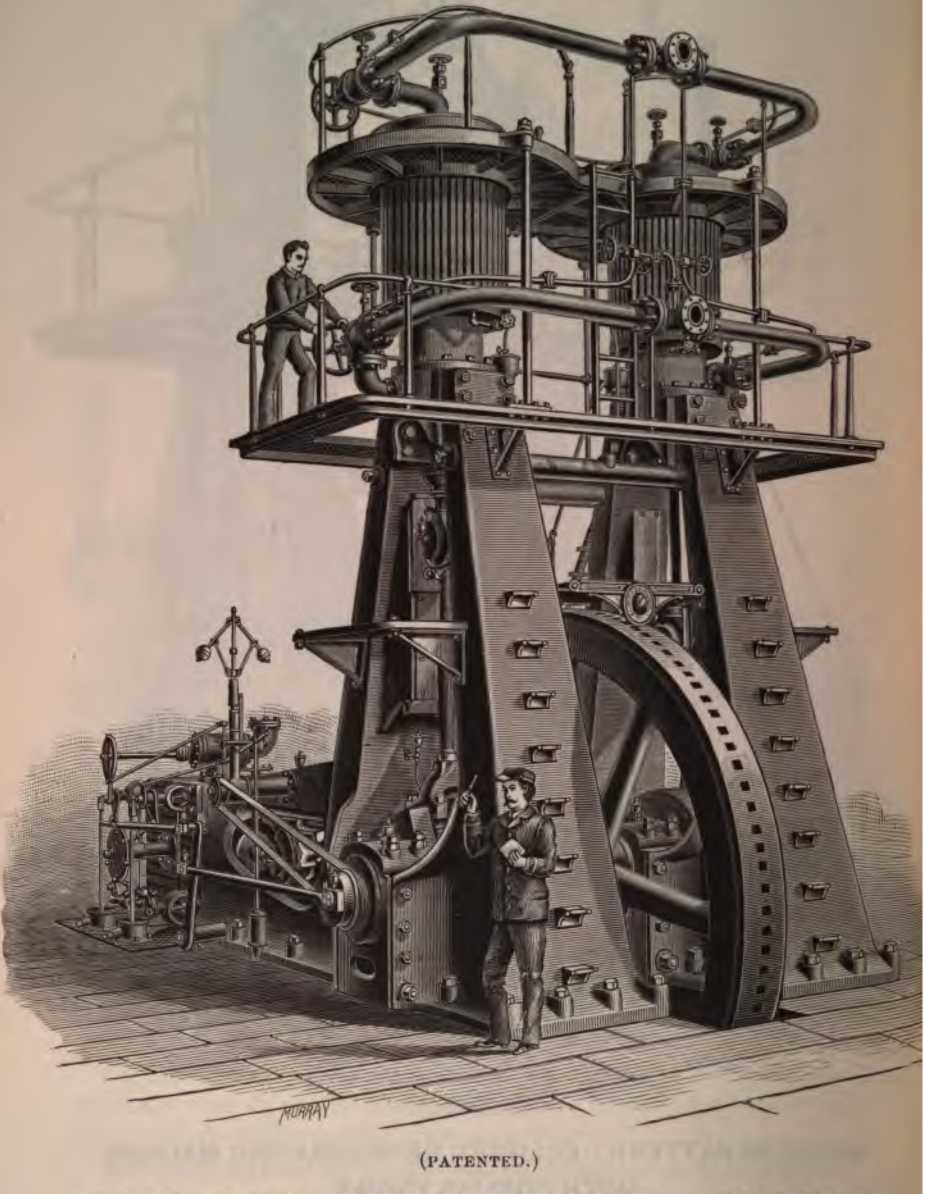
Larger machines shown on pages following.



SECTIONAL VIEW OF OUR SMALLEST ICE-MAKING MACHINE.

See engraving on page 38.

FROM A PHOTOGRAPH.



(PATENTED.)

150-TON ECLIPSE REFRIGERATING MACHINE, ENGINE SIDE, REGULAR PATTERN.

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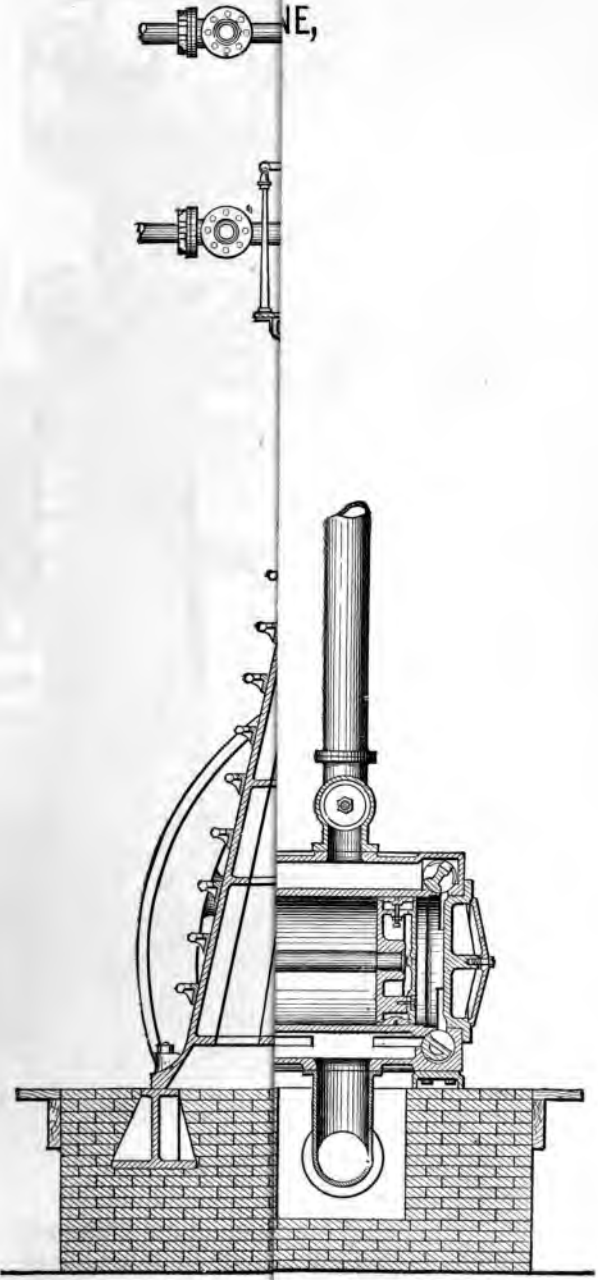

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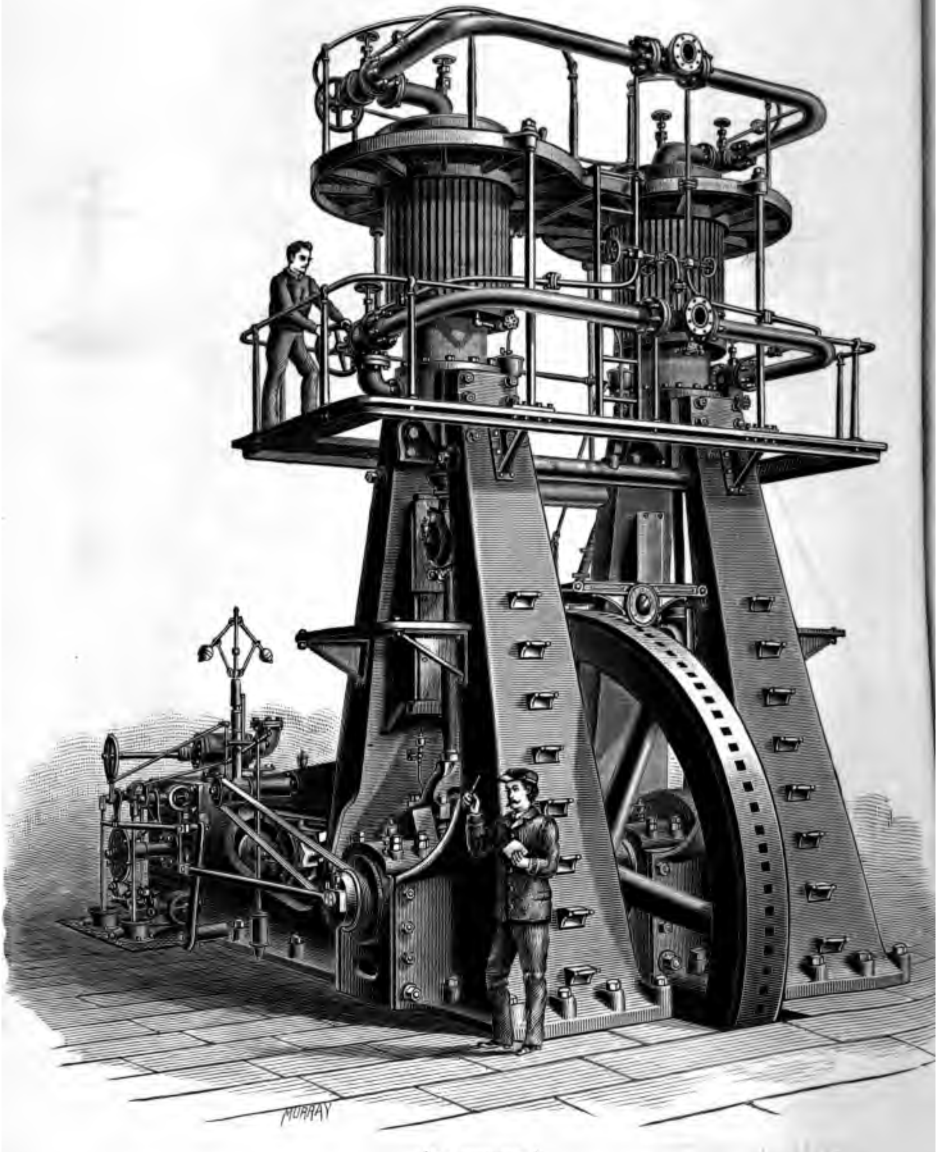

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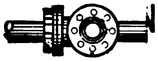
150-TON ECLIPSE REFRIGERATING MACHINE, ENGINE SIDE, REGULAR PATTERN.



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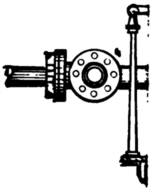

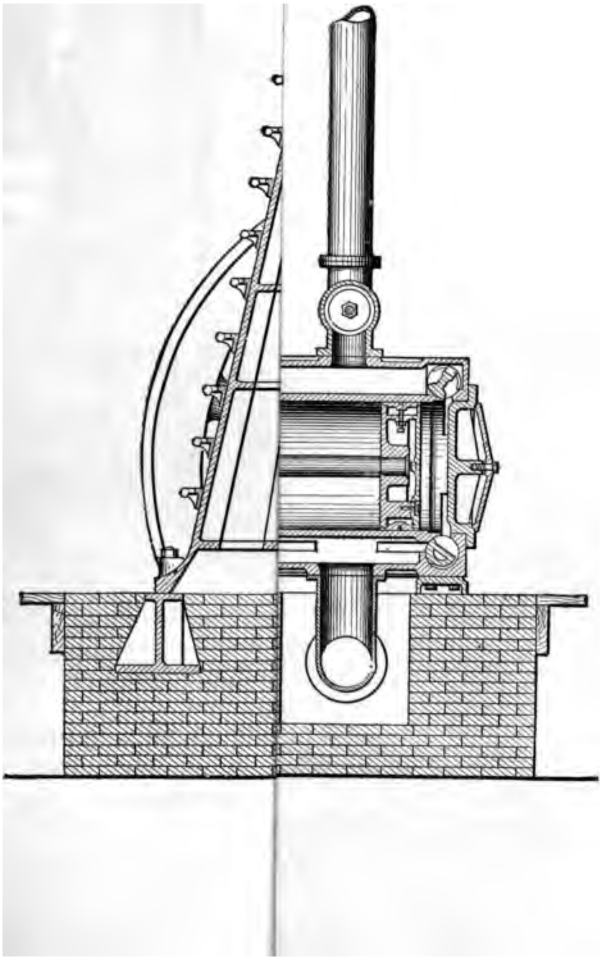

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ASTOR, LENOX AND
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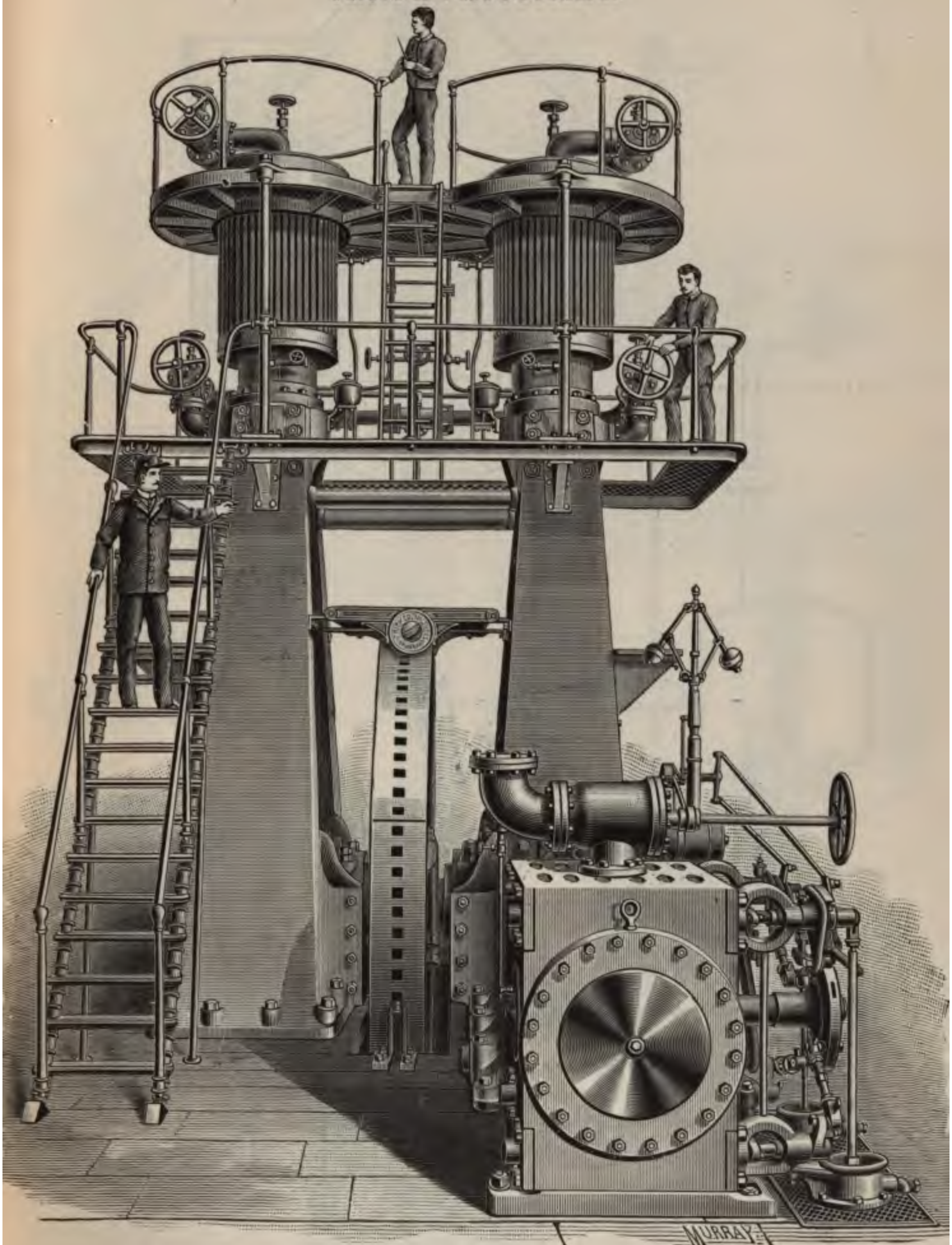
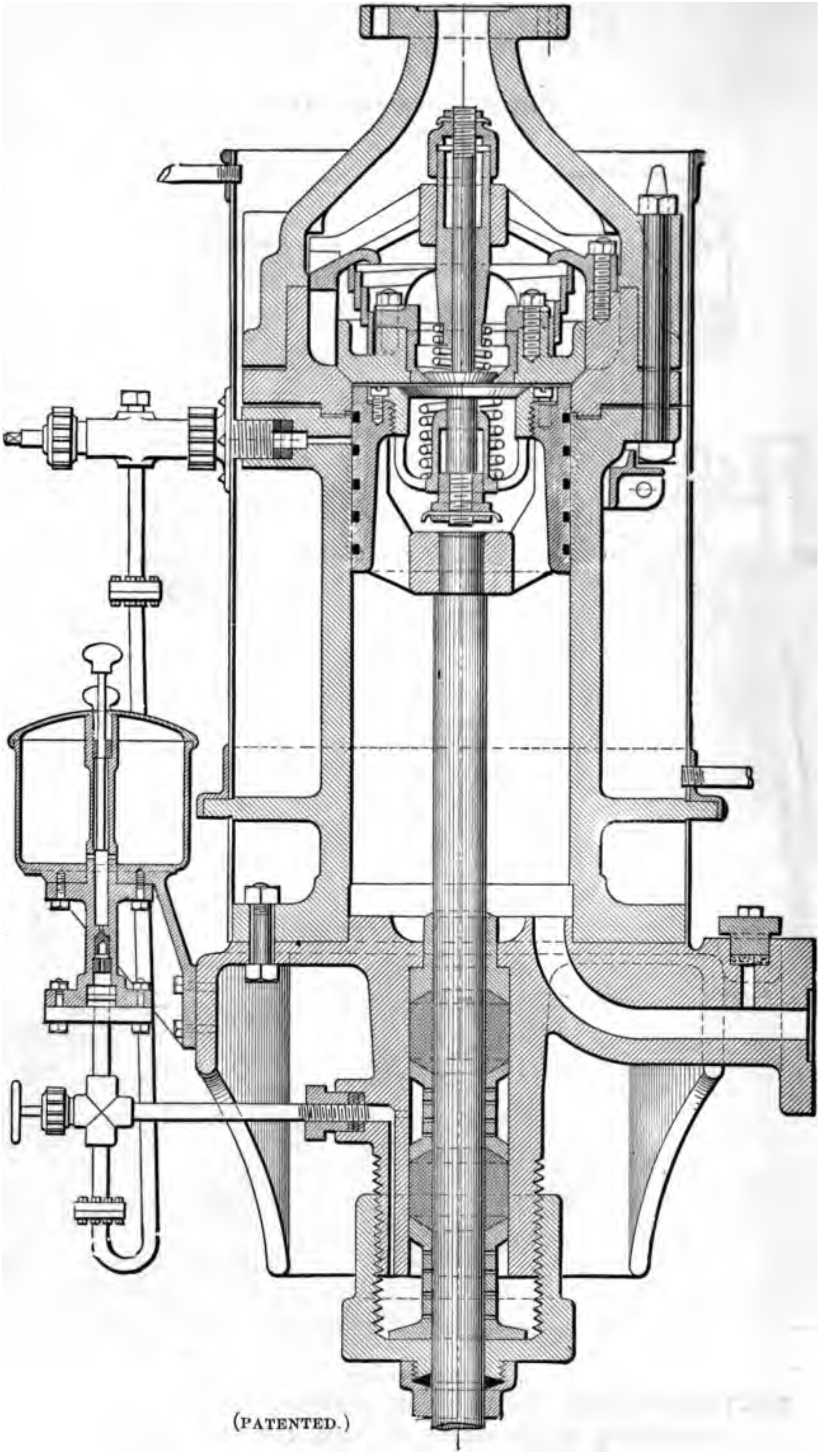


(PATENTED.)

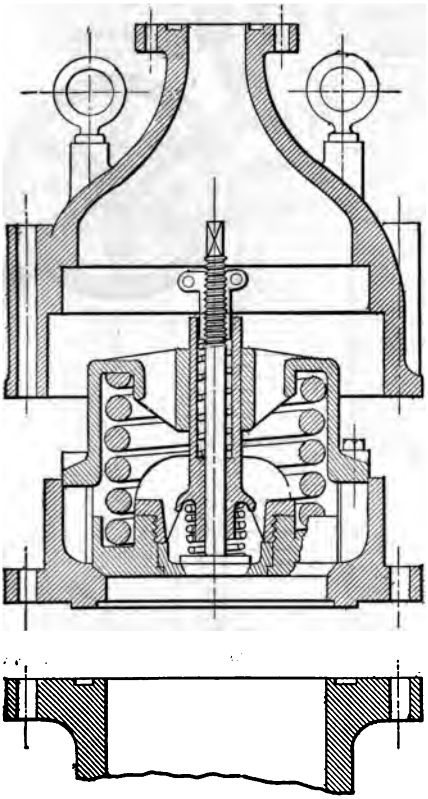
150-TON MACHINE, REAR VIEW. LARGEST REFRIGERATING MACHINES EVER MADE IN THIS OR ANY OTHER COUNTRY. MANY IN SUCCESSFUL OPERATION.

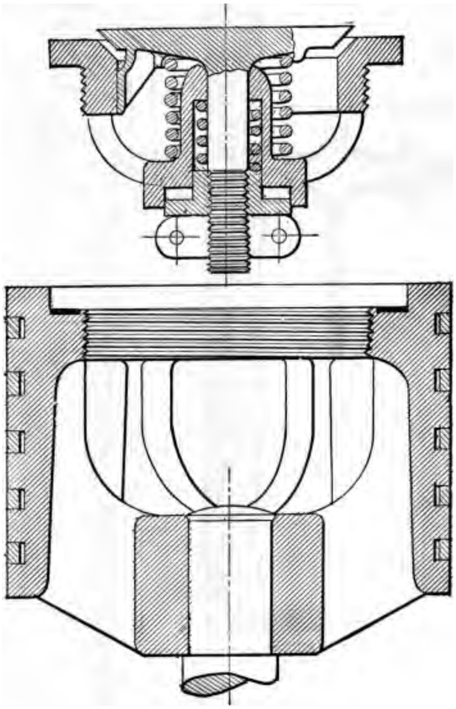


(PATENTED.)

SECTIONAL VIEW OF OUR "ECLIPSE" GAS COMPRESSOR PUMP, NO. ONE.

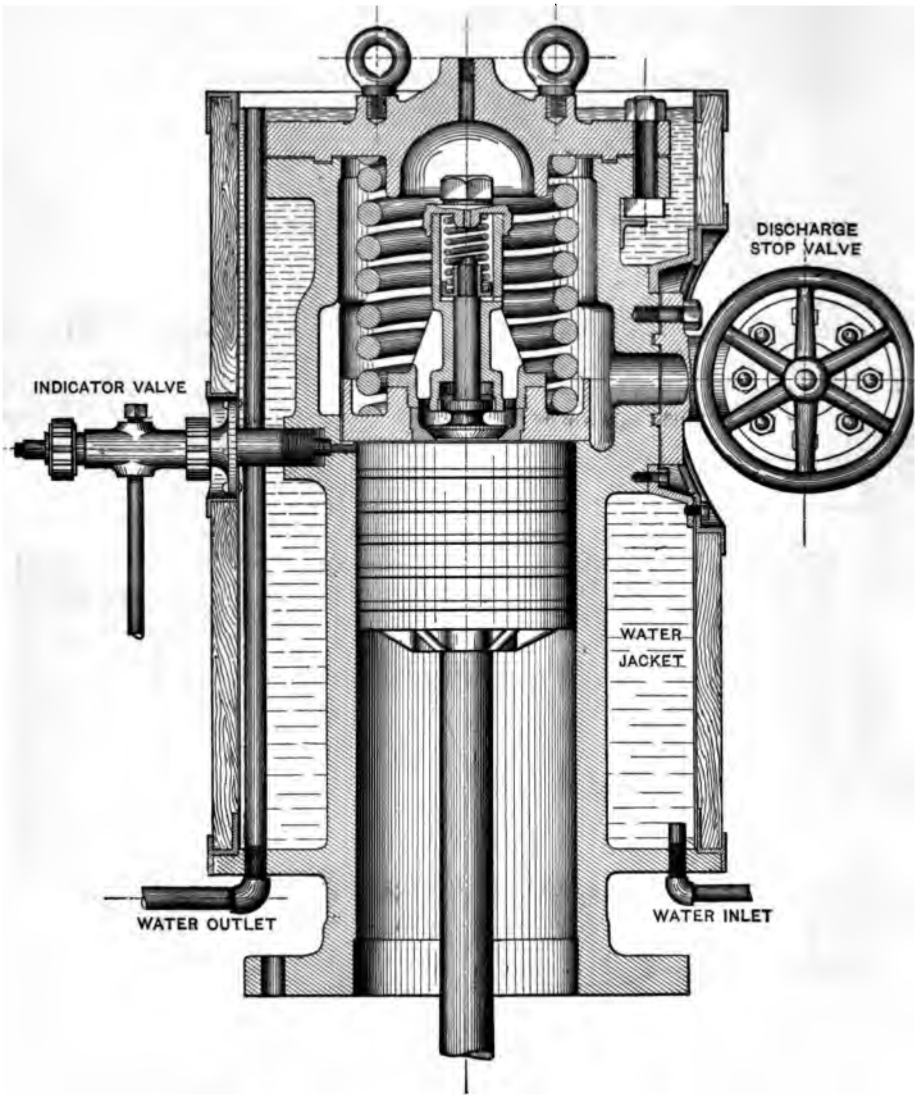
Showing self-contained and removable Valve Mechanism, with Safety Head and Independent or False Seat and Cone Bonnet separate from Pump Casting. See Improved Pump on Page 46.





The engraving on the left hand side shows the form No. 1 of our discharge valve and safety head. It will be noticed that the safety head, removable seat, spring, spider or guide, discharge valve cage and seat are very compact, and all valve mechanism is complete within itself and having no connection with the cylinder or dome head, convenient of access and not subjected to disturbance in making joints or interfering with freedom of valve movement. As it is self-contained, the whole valve mechanism can be removed and a new one inserted.

The right hand side engraving is our Suction Valve and Piston. The valve mechanism in this case also being self-contained and interchangeable. All wearing surfaces and valves are made of hard steel accurately fitted. The performance of our valves and piston have given our machines the name of being the strongest working and most efficient compressors in the market. The valves have adjustments to make them noiseless.



(PATENTED.)

SECTIONAL VIEW OF OUR GAS COMPRESSOR PUMP, NO. TWO.

WITH SELF-CONTAINED PATENT SAFETY HEAD AND IMPROVED DISCHARGE VALVE.

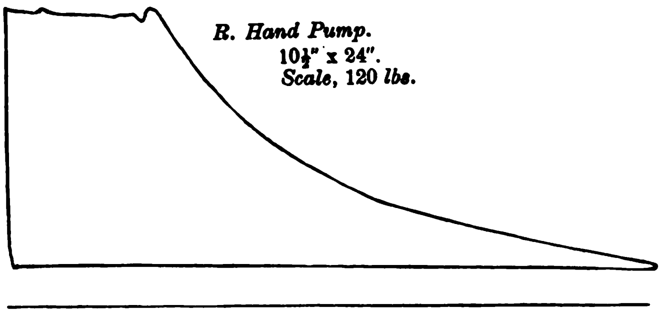
NOTE ESPECIALLY :—That in this construction it is simply necessary to remove the light pump head, which is the work of a moment only, to expose the valve mechanism, which can then be bodily lifted out for examination ; or in case of repair, a duplicate set inserted.

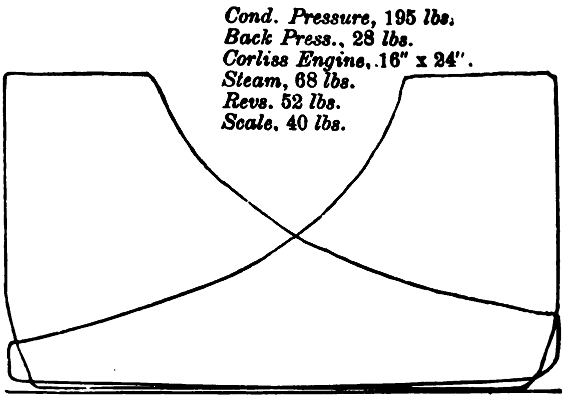
No other joint than the pump head is disturbed, making it the simplest and easiest of access of any pump heretofore introduced.

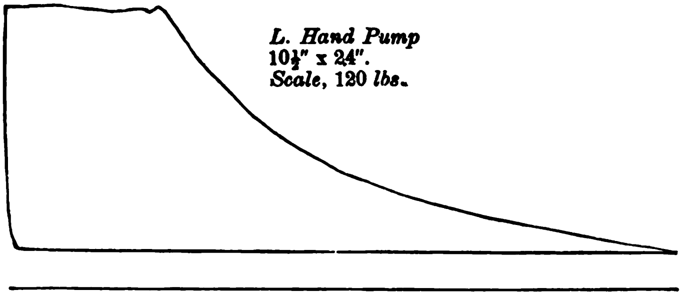
This valuable improvement we have been enabled to perfect without interfering with the remarkable efficiency and performance of our No. One Pump.

The base of the Pump containing stuffing box and lubricating mechanism, is similar to Pump No. One, shown on page 44.

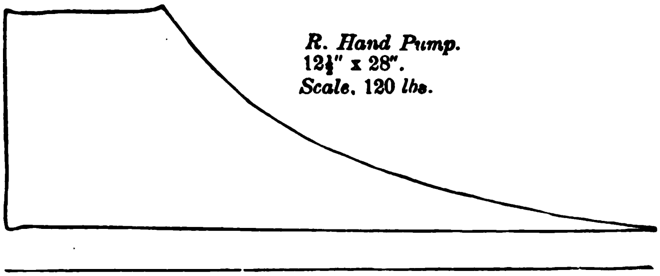
INDICATOR DIAGRAMS FROM 25-TON ECLIPSE MACHINE.

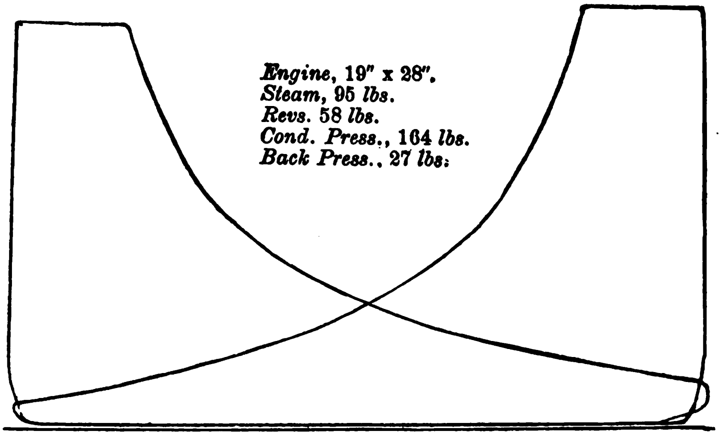


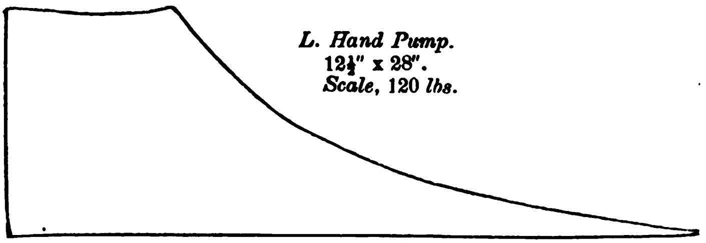




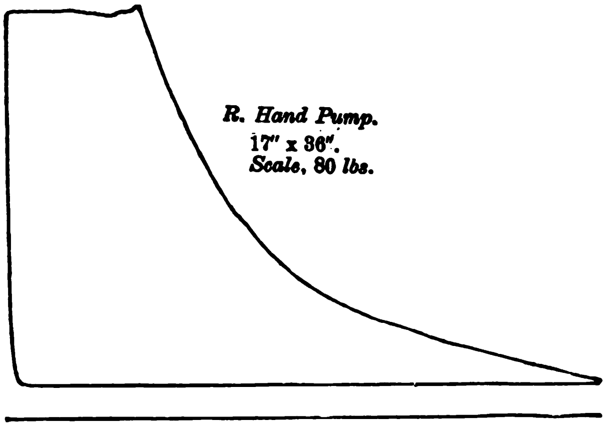
INDICATOR DIAGRAMS FROM 50-TON ECLIPSE MACHINE.

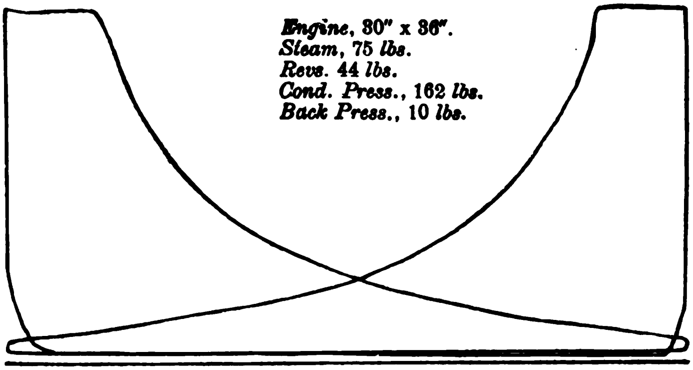


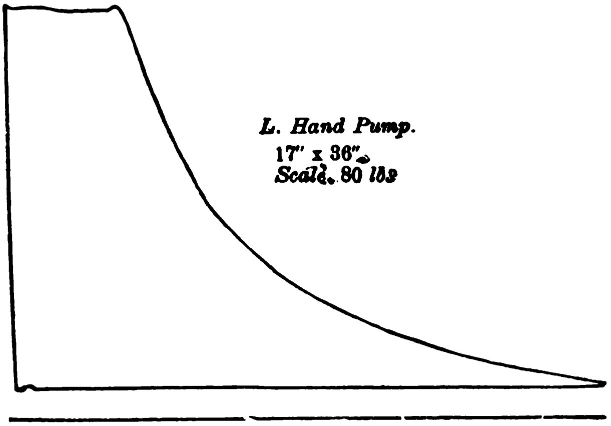




INDICATOR DIAGRAMS FROM 100-TON ECLIPSE MACHINE.







ECLIPSE REFRIGERATING AND ICE-MAKING MACHINERY.

DESCRIPTION.

Our standard machine is shown by engravings upon pages 38 to 43, and by a sectional view upon pages 39 and 41. The engravings in perspective are made from photographs and represent four different sizes: 5-ton, 25-ton, 75-ton, and 150-ton machines, the sectional view on page 42 being that of our 150-ton machine.

TYPE OF MACHINES.

Is seen by the engravings to consist of a pair of single-acting vertical compressor pumps driven by a horizontal steam engine, all forming part of one structure.

ORIGINAL DESIGN.

The principal feature in the design, which is exclusively our own and protected by patents, is the employment of rectangular tapering box girder columns for supporting the pumps. The bottom ends of the columns terminate in a broad base or flange, which finishes flush with the floor line and is bolted to heavy foundation girders. The upper works are provided with a gallery and convenient stairways. On the larger machines, an upper and lower platform are furnished. The fly-wheel is located between the pumps; the connecting rod of the horizontal engine acts directly upon the main crank through an opening in one of the columns. Altogether the design is novel and pleasing, and strikes the observer as being a splendid adaptation for the purpose to which the machine is applied. It will be noticed that the design affords easy access to all the working parts, an unusual advantage in this class of machinery.

THE COMPRESSOR PUMPS.

The most important feature of a refrigerating machine is the compressor pump. To secure the highest efficiency of performance (other things being equal, such as proper application and proportion of the steam engine driving the same, with the lowest obtainable loss of friction in transmission of power to the pump), the pump which receives the fullest charge of gas and most perfectly expels the same is the most efficient *and will do the most work.*

The sectional view of our gas-compressing pumps shown on pages 44 and 46 shows an admirable construction to obtain in the fullest measure these much desired qualities.

PISTON OF COMPRESSOR.

The pump piston is gas-tight, by reason of its excellent fit and extra length, yet moving freely, compensation for wear being provided by using five spring rings, which are carefully fitted.

Particular pains is taken with the pump bore to have it round, parallel and smooth.

SUCTION VALVE.

The steel suction valve, of large area, is situated in the piston, the gas inlet being in the base of the pump. The suction valve being balanced by a spring, presents upon the return stroke of the piston no resistance to the gas, which flows, under the back pressure, with considerable velocity into the vacant space above the piston, *hence no check valve is needed in suction pipe in order to fully charge the pump.* A cushion and spring assists in closing the suction valve promptly and noiselessly as the up stroke is begun, the imprisoned gas being gradually compressed until it equals the condensing pressure acting upon the discharge valves, located in the pump dome, when discharge begins.

INDICATOR DIAGRAMS.

As an evidence of the satisfactory character of the work done by the gas pump, experts will be interested in the indicator diagrams, shown on pages 47, 48 and 49, taken from our 100-ton, 50-ton, and 25-ton machines. The gas, under the treatment it receives in the compressor pump, parts with more or less of the heat of compression through the wall of the cylinder, the dome and cylinder being enveloped by a water jacket, through which the cold water is constantly circulating.

OFFICE OF JACKET.

This jacket water not only prevents superheating of the gas during compression, but besides carries off much of the heat, also materially assisting the condenser and cutting down to a marked degree the gas resistances that would present themselves without its use. As a matter of fact, it is so much gained at the slight cost of the jacket water.

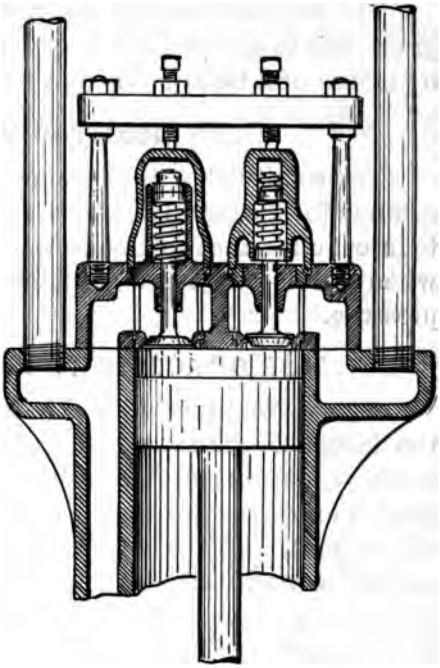
THE SAFETY COMPRESSOR HEAD.

In order to make it perfectly safe to work the piston *metal to metal* against the top cylinder head, the better to expel the full charge without danger, the pump head is made movable, or what may be called a *safety head;* in other words, it is simply a large valve the full size of bore of pump, through the seat of which the piston may pass without injury, raising the head before it sufficient, in case of any part getting loose, that no damage can ensue, such as knocking out a cylinder head, which in some constructions is frequent (see page 53), thus losing the full charge of ammonia gas and endangering life.

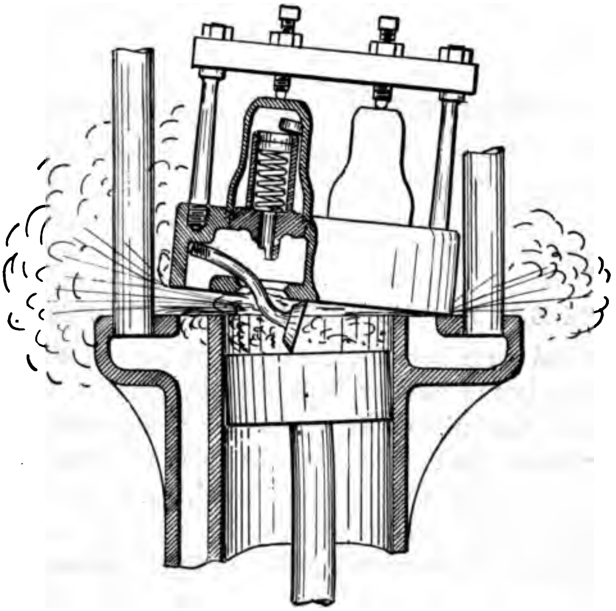
THE DISCHARGE VALVE.

The safety head does not work as a valve, the real operating discharge valve being the small steel valve in the centre of the same. Notice that the safety head with its discharge valve, guides and seat are *self-contained and independent* of the pump cylinder, making it convenient to replace the whole valve mechanism by a duplicate one or make speedy repairs.

A CLASS OF ACCIDENTS WE AVOID.



This style of Compressor Pump has no safety head; and its builders invite accidents of the kind here shown by persisting in the use of the *dangerous* inverted suction valve, which frequently drops into the cylinder, and, being caught in the return stroke of the piston, bursts off the pump head as shown.



PISTON ROD STUFFING BOX AND LUBRICATION.

The stuffing box for the piston rod is arranged with great care to prevent leakage of gas, and amply lubricated by means of a hand pump and oil reservoir.

INDICATOR VALVE.

The small valve at the upper left-hand corner of diagram is for taking indicator diagrams from the pump, and to inject oil in that portion of the cylinder, if any be needed, when starting up a new machine or when testing under air pressure.

EASE OF ACCESS TO PUMP MECHANISM.

A novel feature that will be appreciated when studying the design of our compressor is that *all parts of the pump mechanism are easy of access;* by simply removing the dome head, the valves are exposed to view for examination or adjustment, and the entire valve mechanism can be removed in a twinkling. The peculiar arrangement of the pump dome facilitates the removal of the parts without disturbing the main discharge pipes or stop valve, but one joint being broken. We have been able to make this improvement in our pump without interfering with its former desirable features.

SELF-ACTING VERSUS DOUBLE-ACTING PUMPS.

You will have noticed from pages 44 and 46 that the pump we use is a single-acting vertical one, and also know that a few other builders use double-acting pumps, some of them horizontal.

REASON FOR USING THIS STYLE OF PUMP.

Vertical pumps are not subject to bottom wear of the pistons, as is the case with horizontal pumps, where the weight of the piston is necessarily supported by the cylinder bore, producing needless friction, with a strong tendency to wear the cylinder oval, and more particularly the narrow surface of the piston to such an extent that leakage of gas occurs past the top of same. Part of the weight of the piston is also taken by the piston rod when near front end of cylinder and rests on the stuffing box, which makes it rather difficult to maintain the piston-rod packing.

BALANCED FORCES, SINGLE-ACTING MACHINES.

In the vertical pattern the pump cranks are placed opposite each other and the forces are balanced. The wear of the pump cylinder bore and piston rod, owing to their vertical position, is uniform and very slight, and the saving in friction a considerable item. There are other advantages, such as economy of space, use of a large vertical water jacket, separation of dirt, ease of lubrication, etc.

FREEDOM FROM LEAKAGE, SINGLE-ACTING.

Our single-acting pump *compresses the gas on its upward stroke*, hence the condensing pressure comes only above the piston. This pressure ranges from 125 pounds upwards per square inch. The space below the piston being subjected only to the low suction pressure of gas ranging from 0 to 35 pounds, hence in our single-acting machine the stuffing-box packing is more easily kept tight without undue wear and friction of the piston rod as in the double-acting pump, which, having to *compress gas on the lower stroke* to condensing pressure, necessitates a tight stuffing box, which causes undue friction, heating and wear of piston rod.

In the single-acting pump, because of the low pressure on the piston packing box, the leakage of ammonia past the piston rod is easily prevented. This in itself is an important saving.

Double-acting pumps on their downward stroke do not expel all the gas, owing to the fact that it is impracticable to use an arrangement of outlet and inlet valves to avoid large waste spaces. These clearance spaces are filled with compressed gas on the downward stroke; part of the charge that is compressed is not expelled, and expands back as the piston recedes, thus preventing the reception of a full charge on the next stroke, and again with a leaky piston the gas plays hide and seek back and forth past the same with great loss of power.

ACCIDENTS TO DOUBLE-ACTING PUMPS.

Another defect of a double-acting pump, and a most serious one, is that in case of accident the machine must be stopped until the part is repaired, a slight accident to one of the valves, pistons or parts *disabling the whole machine.*

ACCIDENTS TO SINGLE-ACTING PUMPS.

In case of accident to our single-acting pump, the suction and discharge stop valves may be closed on the disabled pump only, and the other pump *may continue to run,* and in most cases, if speed is increased, *the work will go on the same as before,* the disconnected pump being examined or repaired at leisure.

TWO STRINGS TO YOUR BOW.

Either one of our single-acting pumps can be driven singly. This, as above described, is an important advantage over any single double-acting pump.

THE STEAM ENGINE.

Next to the compression pump itself, the steam engine that drives it is of the greatest importance, and upon it depends to large extent the economical results obtained, and it is upon this point, among others, that we profess to have a very great advantage over those who are not engine builders or experienced engineers. Our large experience is called into play in establishing, in the first place, the proper proportion and size of steam engine to drive a given size gas pump under the conditions of its use, and, in the second place, in so perfecting this engine that it will do this work with the maximum fuel economy and minimum wear and tear.

THE ENGINE PART OF THE DESIGN.

You will notice that the steam engine in our design is an integral part of the machine and incorporated in the structure, the construction being such that engine and pump are self-contained. The engine rod connects directly upon one of the pump crank pins, and the relative position of engine and compressor is such that economy of transmission is secured and a delivery of the power of engine to the pumps effected in the most perfect manner possible during the maximum periods of compression, the heavy fly-wheel securing uniform motion.

HORIZONTAL ENGINE.

The engine, from its horizontal position, is more convenient for access of the engineer, and all important parts coming constantly under his eye are easily cared for, dispensing with the climbing of stairways. (We make a note right here that the vertical pumps require very little attention.)

TYPE OF ENGINE USED.

Depends upon the conditions and size of machine. We use our Eclipse Corliss Engine on all the larger sizes, making them non-condensing, condensing, compound, and compound condensing, as suits the case in hand and abundance of water supply.

CORLISS ENGINES.

By reference to the chapter devoted to our Eclipse Corliss Engine, detailed information can be obtained of their construction.

CUT-OFF AND SLIDE VALVE ENGINE.

On the smaller sizes, and for ice-factory use, where the economy is limited to the production of distilled water actually required to make the ice (exhaust steam being used for this purpose), we employ the simplest form of engine, as shown in cut, page 40, arranged with cut-off in certain cases, so the maximum economy can be adjusted.

WEARING AND BEARING SURFACES.

As all things made by man are subject to wear, hence the bearing and sliding surfaces have adjustments for compensating the same. It is of course understood and admitted by all, workmanship and material being equal, that the strength and extent of wearing surfaces determine the lifetime of a part. This fact we have recognized, and a comparison of the wearing and bearing surfaces of our "Eclipse" machine with any other in the market is desired by us.

A WORD ABOUT FLY-WHEELS AND "CRANKS."

Our readers, of course, know the office of a fly-wheel in a steam engine or a refrigerating machine. Its function is to secure uniformity of rotation and smooth running. It performs its part by storing up power at certain periods of the stroke when the engine is delivering a surplus, and transmitting or giving back this power during periods of the work of compression or when passing the crank centres. The work stored in the fly-wheel is expended directly through the crank-shaft to the pump wrist-pins, and the amount of energy thus stored and again exerted during a short space of time and fraction of a revolution is something enormous: so much so that good engineers recognize this and always place the fly-wheel in such a position that not only is there no danger of straining the crank-shaft, but also at a point where the fly-wheel's energy may be *equally distributed;* and especially avoid the necessity of its forces acting through a double throw crank to a distant part of the machine, as it has been found that it is only a question of time until all cranks so subjected to double work and intermittent strains will fail.

LOCATION OF OUR FLY-WHEELS.

The fly-wheel on our "Eclipse" machine is located between the pumps, and the power is transmitted equally and directly to each pump crank-pin. Again, the fly-wheel is placed upon the main shaft, and supported between the principal fixed bearings, which cannot get out of line; and *not upon an extension to the crank-shaft,* as in some constructions where great errors of engineering judgment have been displayed, and two double-throw cranks are used with, in some cases, an outside and altogether independent and "go as you please" bearing, which makes it difficult to maintain alignment with the fixed main bearings on machine proper, thus throwing an additional wrenching strain on the already overburdened double-throw cranks through which the fly-wheel energy is sent. This practice may be slightly better than to leave the *whole weight of fly-wheel to overhang* on the double-throw crank, and of the two evils may be the least; but time will tell, and good engineering practice eventually assert itself in opposition to such dangerous constructions that would only be tolerated when something better could not be found.

A PECULIAR BUSINESS.

The business of Refrigeration is a peculiar one, and can be compared in many respects with the motive power of a ship, upon which the safety of the vessel depends in adverse weather, and especially when in dangerous proximity to a "lee shore." In such cases, if the motive power becomes disabled, the craft is dashed to pieces on the breakers. To make the comparison plain, we would explain that in these modern days of artificial refrigeration, large industries are absolutely dependent upon the machinery that produces the cold. The storing of natural ice in the buildings to be cooled, upon which industries formerly depended, has been abandoned, and the ice-house converted into cold-storage rooms. Thousands upon thousands of dollars of perishable goods, in most instances, are *absolutely dependent* upon the integrity and reliability of the refrigerating machine and apparatus—an accident that permanently disables the machinery or a stoppage of a few hours (*especially the direct expansion system which has no reserve as has the brine system*) means heavy losses. *You are running along the "lee shore" all the time* and must keep things moving. We realize this important feature in the business, and have guarded against such disaster by making all parts of our machinery immensely strong and especially adapted for their peculiar work.

HOW LONG WILL OUR MACHINERY LAST?

This is a pertinent question and well put. We know from experience and can guarantee our machinery to last as long as any of the very best makes of steam engines, and it is safe to say, from critical observation, that our machines will last a generation, if properly cared for.

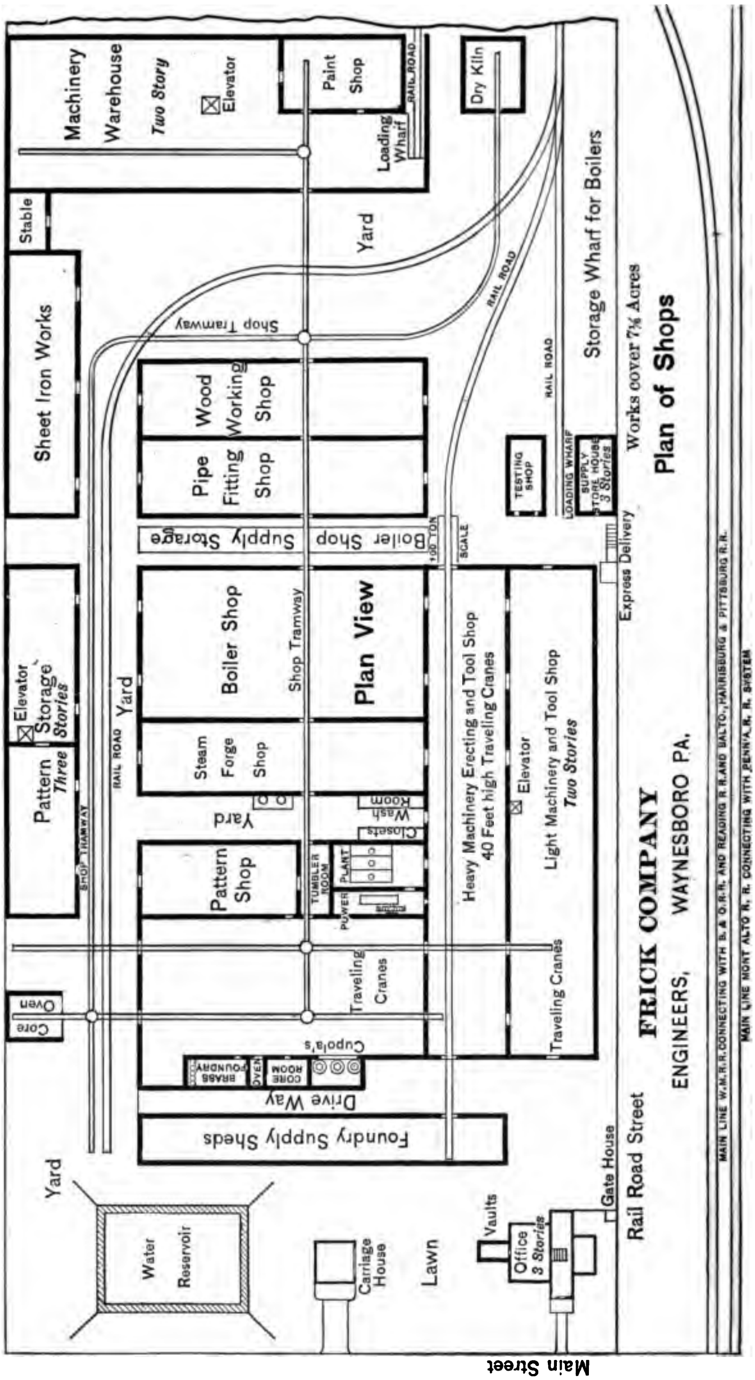
GIVING MACHINERY A NEW LEASE OF LIFE.

We wish it known that all the wearing parts of our "Eclipse" machines are replaceable and made *interchangeable,* provision being made for renewing every part subject to wear. As a rule, these parts are comparatively inexpensive, and the renewal of such details means as good as new. By this arrangement the standing or principal members of the machine are preserved from wear, and will last indefinitely. While the wearing parts are made as above described, on the detachable plan, do not understand us to mean that this system of construction is adopted as a makeshift to secure cheapness, and that the parts are more liable to wear than if made differently. The contrary is the case. It is simply a question of preserving the original integrity of the mechanism, to insure long life and interchangeability of parts in case of repair.

FRICK CO. STEAM ENGINE & BOILER WORKS

ALL THE WORK DONE IN OUR OWN SHOPS.

Our works cover over seven acres and furnish employment to upwards of 800 skilled men, who produce all parts of the refrigerating and ice-making machinery and apparatus furnished by us. The various departments of the works include *large machine shops,* fitted with a heavy plant of special and general tools, second to none; an *extensive foundry, steam forge, general smithy, pattern shops, wood-working shops, testing shops, pipe shops, boiler, tank, sheet-iron and tin shops.*



PLAN OF FRICK COMPANY WORKS, WAYNESBORO, PA.

NEW ERECTING SHOPS.

We have just made important addition to our shops not shown in engraving, (see plan, page 62), in the shape of erecting rooms over 315 feet long, 40 feet high. All handling of heavy work throughout the works is done by steam traveling cranes, and every facility is brought into play for the purpose of building refrigerating and ice machinery cheaply, expeditiously, and as perfect as it can be made. We are quite safe in saying that no other establishment in this line of business in the United States is so well equipped and produces so many of the parts belonging to refrigerating and ice-making machinery and apparatus as ourselves. We mention this fact to say further that we do all our own work to secure general excellence of work and to support us in our statement that we can and do produce, with our equipment of men and tools, first-class work, as good as it can be produced, and, further, that intelligent and worthy competition is courted by us, as in prices, quality, economical results, and reliability of our machinery, we hold our own.

TESTING MACHINERY BEFORE SHIPMENT.

This important department of our works is fitted with special machinery for testing every machine, part and piece of our ice-making and refrigerating machinery through which ammonia passes. Two methods of testing are used, one of which is hydrostatic, and used to determine the strength of parts ; the other is the pneumatic test, with parts submerged under water for the purpose of detecting leaks. Not a detail or fitting escapes these tests. The water test is 1200 to 1500 pounds per square inch, and with air from 300 to 600 pounds.

ALL MACHINERY RUN UNDER STEAM.

All our "Eclipse" machines are put together in the works before shipping and run until perfected under working pressures.

EXPERIMENTAL APPARATUS.

We have erected in our works an experimental plant for refrigerating and ice-making, and special apparatus upon which all improvements are fully tested with standard instruments and all experiments are conducted by experts, thus insuring to our customer, without expense to him, all devices worth having and found by ourselves practically to be of merit are introduced as fast as found to be worthy of a place upon our machinery.

AMMONIA PIPE AND COILS.

All pipe-bending, endless coils and special steel forgings for flanges, valves and fittings, so largely used in our work, are made by us with the aid of skilled workmen and special machinery designed for the purpose. We were compelled to do this in order to secure a better grade of work than found in the market, the question of temporary cheapness being abandoned to obtain unquestioned superiority of product and real economy.

SPECIAL NOTICE.

Besides manufacturing for sale a full line of ammonia fittings, consisting of valves, elbows, flange unions, tees, reducers, headers, bends, etc., we will supply to the trade fittings, evaporating coils (flat or round), ice cans, distilling apparatus, and other details needed for equipment or repairs, brine and freezing tanks, steam boilers, any one of our full line of gas compressors; also Corliss Engines for use on refrigerating machine; and solicit placing new Corliss cylinders on machines now in use.

A CAMPAIGN LIE NAILED.

Our friends the enemy (unscrupulous competitors), we learn, as we canvass the country at large, tell amusing stories to purchasers (amusing to us and to those who know our concern best and others who have had dealings with us), which in all cases are campaign lies. They strive to create the impression that we don't know how! and can't build Refrigerating and Ice-Making Machinery, because they are told we build plows, harrows, corn-cutters and things we never have built or dreamt of building.

When they come across some of the magnificent plants that we have produced for refrigeration and ice-making, they are paralyzed just long enough to take a fresh breath and assert: "Well! anyhow, they don't build many." "They don't make a specialty of it." "It is only a side issue," etc., and, of course, "you know that they have not been in this business long enough to get all the secrets of the trade and they can't understand it."—(Poor fellows, they have not got them all themselves); and then with a sudden inspiration they say: "*Their machinery is too heavy,*" and "the work can't be good because they are in a little country place and the people down there aint up to snuff" (which we take to mean dishonest). The burden of their talk is to create a false impression and prejudice the mind of the purchaser against our work in this line, on the plea that we have and are still, by reason of our large facilities and abundant capital, carrying on in an entirely separate department of our extensive establishment, the manufacture of steam engines.

We invite you all to visit our works in Waynesboro, Pa., and see for yourselves that we are still building our Eclipse Refrigerating Machine, and building it in a business-like way, and making a specialty of it too. Our out-put in this branch will surprise our competitors and make them more jealous than ever of our great success.

CHAPTER IV.

OUR AMMONIA FITTINGS.

PATENT BYE PASS FOR SAVING AMMONIA.

PATENT SURFACE AND SUBMERGED AMMONIA CONDENSER.

AMMONIA APPARATUS.

AMMONIA PIPE SYSTEM AND DETAILS.

ILLUSTRATIONS OF BRINE AND DIRECT EXPANSION SYSTEM.

ADVANTAGES OF THE BRINE SYSTEM OVER THE DIRECT.

PIPE WORK IN THE APARTMENTS TO BE REFRIGERATED.

ERECTING OF OUR MACHINERY BY SKILLED MEN.

READ HOW SOME OF OUR COMPETITORS DO CHEAP PIPE WORK THAT WILL TUMBLE DOWN, AND SCREW SMALL PIPES OR COIL FEEDERS DIRECTLY INTO THIN MAINS, TO SELL THEIR MACHINERY AT A LOW COST.

BYE PASS ON OUR GAS PUMP.

The usual method in vogue by other builders, when any part of their apparatus is taken apart for examination, is to break a joint and allow the ammonia to escape before they can get at the part, thus wasting it; and this at times, in close rooms adjacent to fire, somewhat dangerous. We, however, provide a "Bye Pass," located on the Pump platforms, enabling the engineer to exhaust the ammonia from any part of the system (stop-valves being furnished to isolate every part), and store the ammonia in any other part temporarily until the repairs or examinations are made.

The "Bye Pass" is also used for exhausting the pumps themselves before the heads are taken off for examination. By means of its peculiar arrangement of pipes and valves we are able to reverse the action of the pumps and exhaust the ammonia from the condenser, storing it in the brine tank.

In each case, after the examination of any part, the air can be exhausted therefrom and charge of ammonia re-introduced without the admixture of air.

The operation of the Bye Pass may be understood from the following illustration and description:

OUR PATENT BYE PASS.

A, B, compressor pumps; A^1, A^2, main discharge stop-valves; B^1, B^2, main suction stop-valves; 1, 2, 3, 4, 5, 6, bye pass valves; M D, main discharge pipe; M S, main suction pipe; 7, 8, 9, bye pass pipes.

OPERATION.*

To exhaust gas from pump B, all bye pass valves closed to begin with; close main stop-valve B^1, B^2 and A^2; open bye pass valves 2 and 3; by running pump slowly the contents of pump B can be exhausted; then shut valve 4 and remove bonnet. After closing bonnet, air can be removed in same way, previously shutting main stop-valve A^1 and expelling the air through purging valves 10 on pump-head; close all bye pass valves when done and open main stop-valve.

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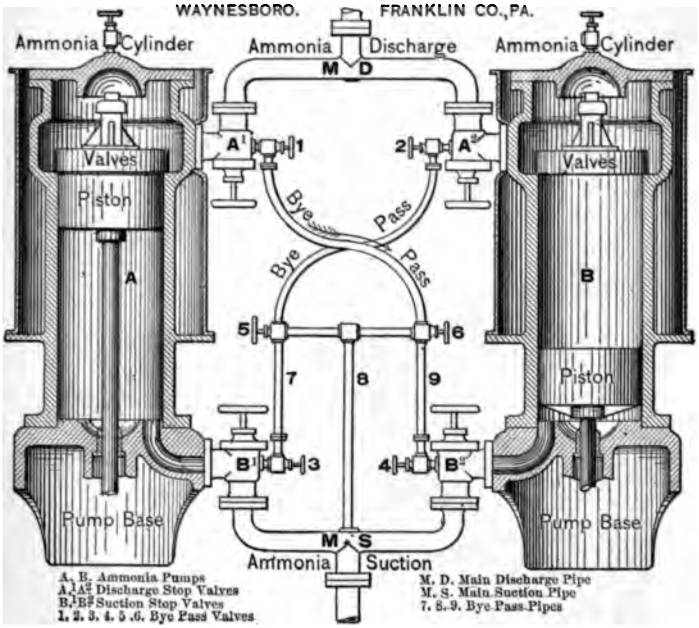
* Except when in use, all bye pass valves are kept closed.

To exhaust pump A, proceed in same manner, using the opposite set of valves.

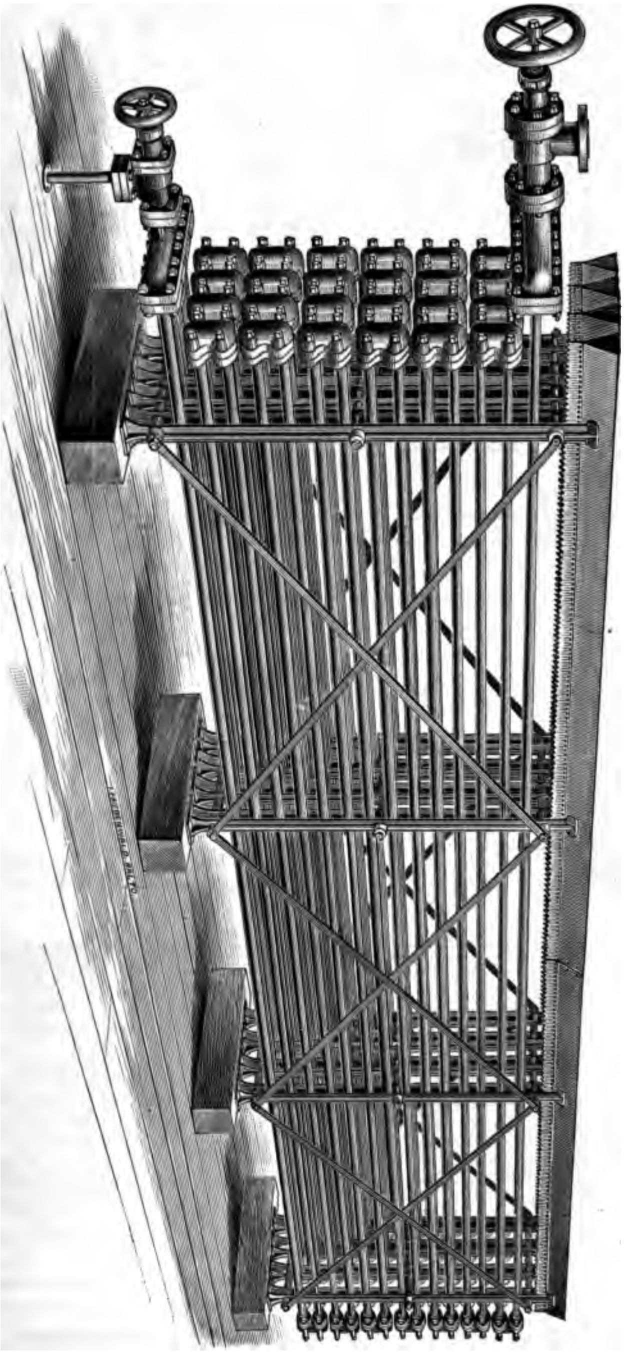
To equalize pressure between Condenser and Brine Tanks, open stop-valve A^1 or A^2 and bye pass valves 1 and 2, also 5 and 6, thus forming passage direct from main discharge to main suction pipe.

Complete Bye Pass Arrangement
ON OUR GAS COMPRESSORS
FRICK COMPANY
ENGINEERS
WAYNESBORO. FRANKLIN CO., PA.



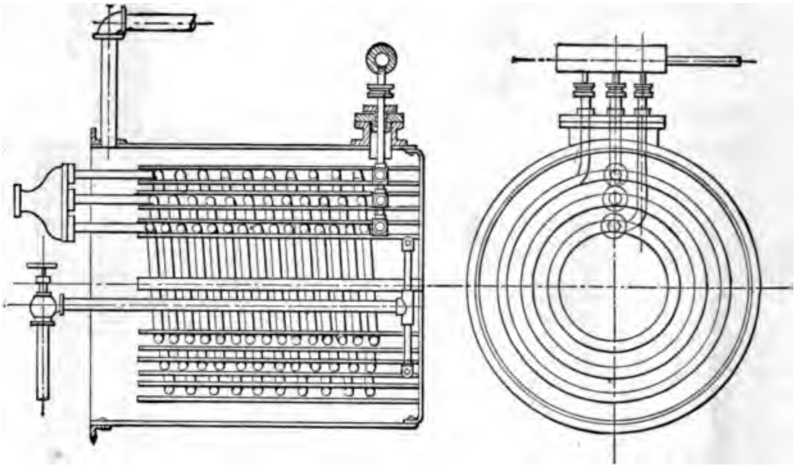
To exhaust Condenser and store gas in Brine Tank. All valves closed to begin with. Open stop-valve A^1 on pump A, bye pass valves 1 and 4, opening communication to pump suction B, expel gas by opening bye pass valve 2 and 5, thus discharging into main suction pipe. Run pumps slowly by using opposite set of valves, either pump may be used, the *modus operandi* being simply that one pump is used to aspirate the gas through the bye pass from the discharge, while the other forces it through the other half of bye pass into the suction pipe.

The convenient arrangement of this bye pass, and good uses to which it can be put, commends it to practical men.

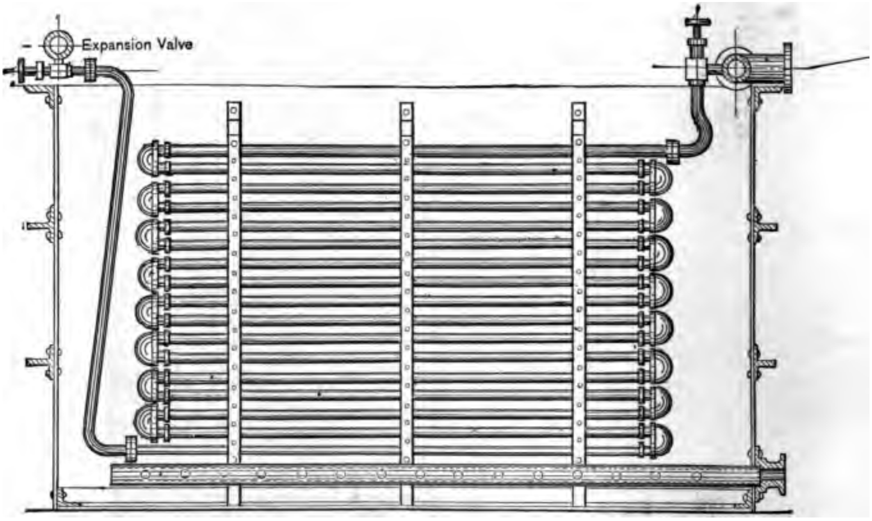


FRICK COMPANY SURFACE CONDENSER.

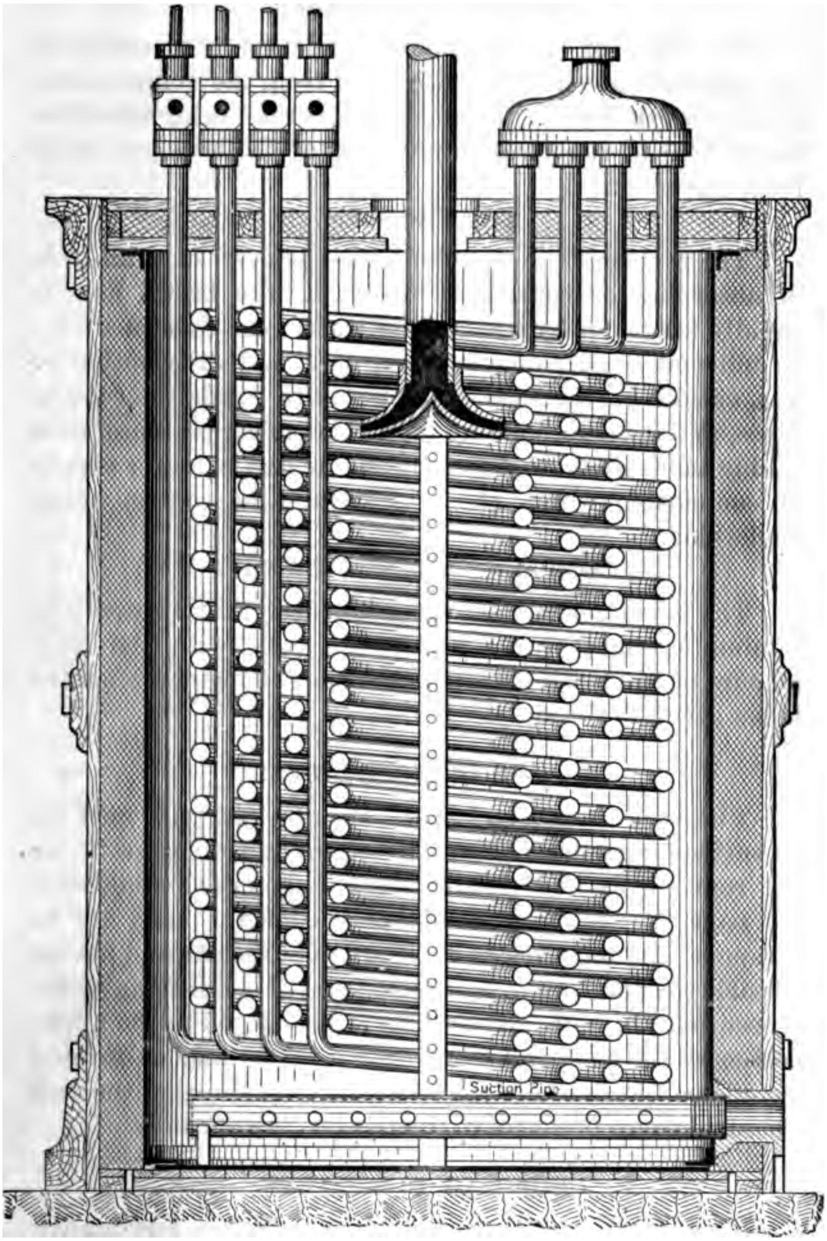
(PATENTED.)



Submerged Condenser, Round Coils and Tank.



Square Brine Tank with Flat Coils; also used for Condenser, with slight changes in coil connections.



CIRCULAR BRINE TANK

Endless round coils, showing tank insulation.

AMMONIA CONDENSER.

The office of the Ammonia Condenser is to condense the ammonia gas as it is discharged from the compressors, and the work done in the condenser is the taking up of the latent heat of vaporization plus part of the heat generated by compression.

THE PROBLEM.

The problem is to distribute the gas over such an area of absorbing or cooling surface that the latent heat is rapidly taken up by the cooling water and carried away. Insufficient condensing surface, or a bad distribution of gas, entails an increase of temperature inside the cooling pipes, and a corresponding high condensing pressure, thus taking more steam to drive the engine and a larger supply of condensing water, the loss from these sources being deplorable.

COMPARISON OF EFFICIENCY.

The arrangement of the condenser that secures the minimum temperatures within the coils with the least amount of condensing water is the most efficient, preference being given to the simplest form.

STYLES OF CONDENSERS.

Two styles are used by us: The straight pipe open air or surface condenser shown by engraving on page 71, or. the round coils and circular tank, submerged condenser, see page 72. In both these condensers the coils are so arranged that an efficient distribution of the gas and lowest possible temperature with least amount of condensing water is secured. In both, the hot gas is discharged in the upper portion of the coils and liquid drawn off as fast as formed from lower portion into the receiver, thus securing the full use and benefit of entire condenser cooling surface.

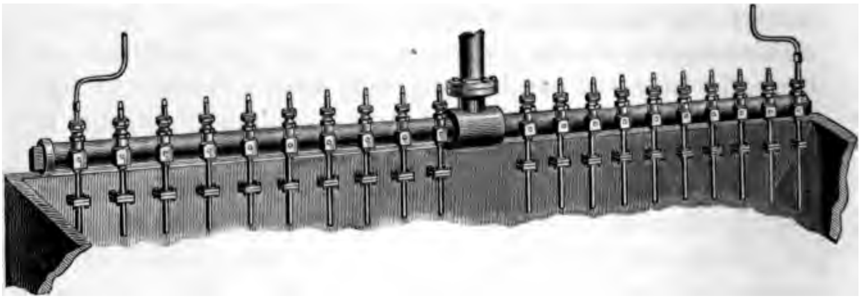
CHOICE OF CONDENSER.

Depends upon the proposed location of same and quality of the condensing water. If condenser is to be placed on the roof or in a room having weak floor timbers, because of its light weight, we would recommend the open air condenser, especially if the water is muddy and rapidly deposits a thick coating on the pipes: as the open air condenser is easy of access and can be kept clean with a broom. If the water is clear and timbering strong enough to support a submerged tank in a closed room, or but little room to spare, it being more compact than the open style, we use the round coil submerged condenser. The work done by either of our condensers by comparison with the complicated apparatus and false arrangement of others has resulted to our satisfaction, and we notice with pleasure that improvements are being made by our competitors in their condenser, which indicates that our practice is the correct one.

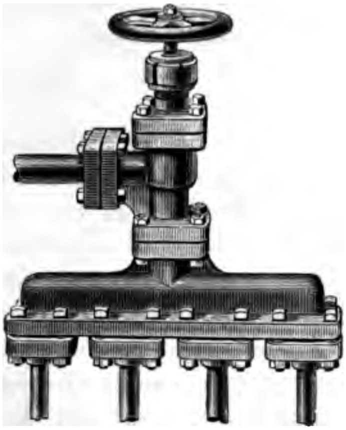
REMARKS.

We may say in passing that the free use of lubricant in the compression system leads to coating of the inner surface of the condenser coils with a thin film of the oil, which, acting as a non-conductor, reduces the efficiency of the condenser. The use of high condensers made up of a great many interposed pipes has been proven in practice to be not nearly so effective as our construction, and its use has been abandoned. In submerged condensers the theoretical conditions to secure the best results are present, viz. the coldest water to come in contact with the coldest gas, and rising in tank, becoming warmer as it meets the warmest gas and finally passing off through the overflow. Ordinary every-day practice and careful tests, however, do not show any marked difference in the performance of the best open air and submerged condensers. The choice is governed by the proposed location.

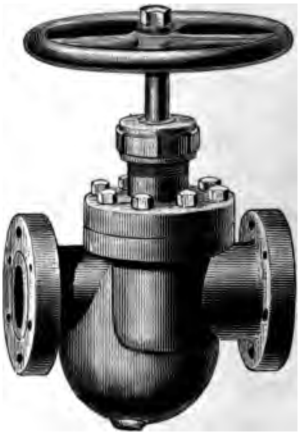
AMMONIA FITTINGS.



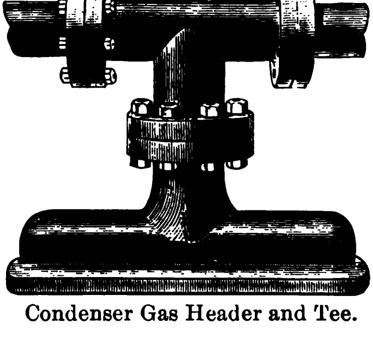
Brine Tank Gas Header in position at end of Tank.



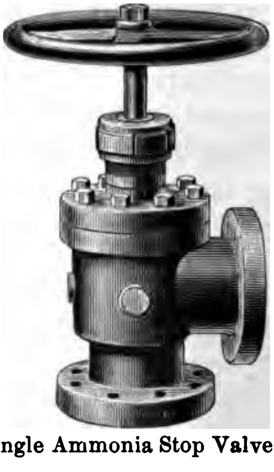
Condenser Liquid Header and Shut-off Valve.



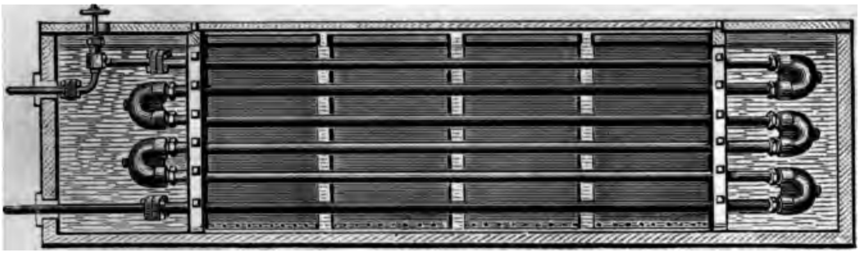
Straightway Ammonia Stop Valve.



Condenser Gas Header and Tee.

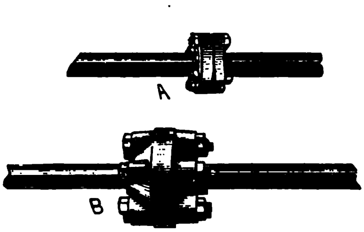


Angle Ammonia Stop Valve.

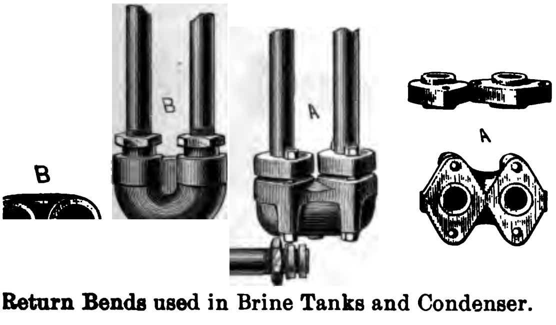


Flat Coil Work in Ice Tank.

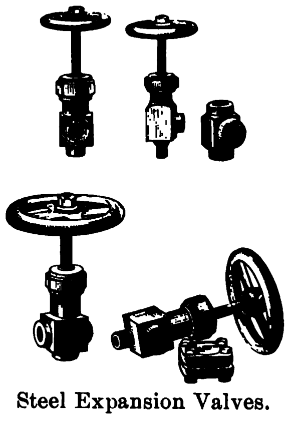
Round Coil Work.



Pipe Couplings.

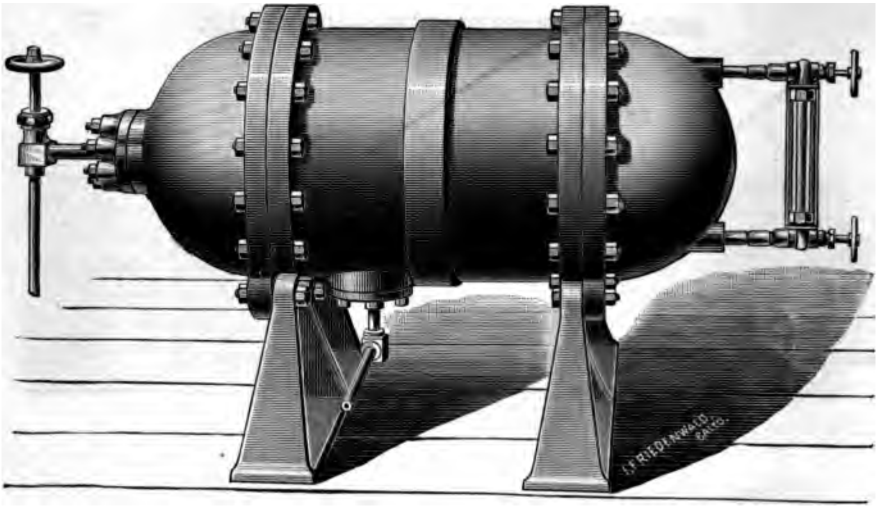


Return Bends used in Brine Tanks and Condenser.

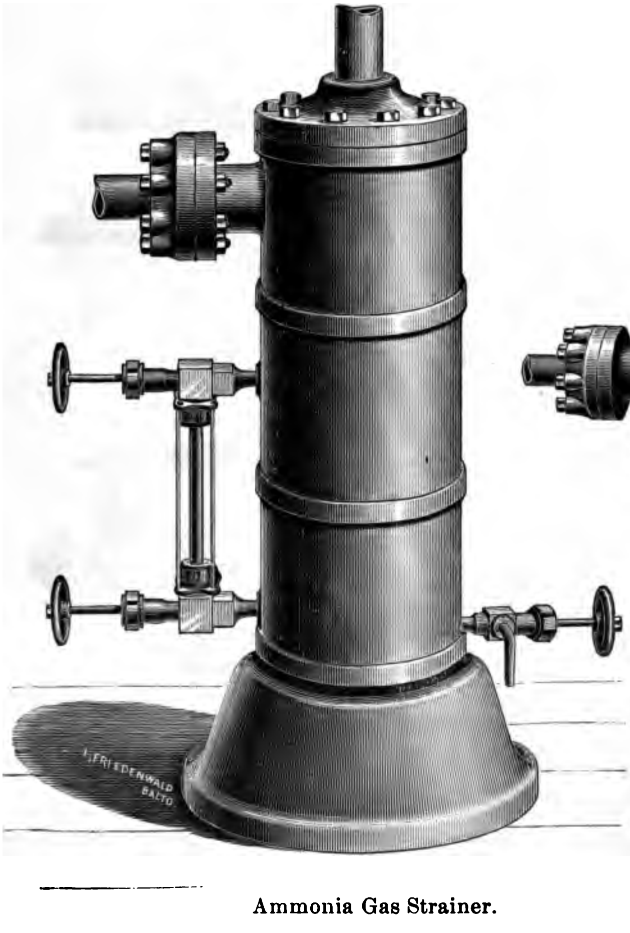


Steel Expansion Valves.

AMMONIA FITTINGS.


I. FRIEDENWALD BALTO.

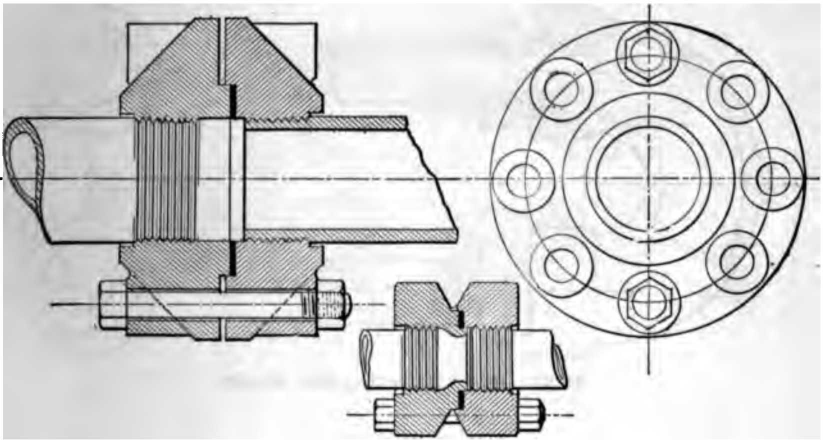
Ammonia Liquid Tank or Receiver.


I. FRIEDENWALD BALTO.

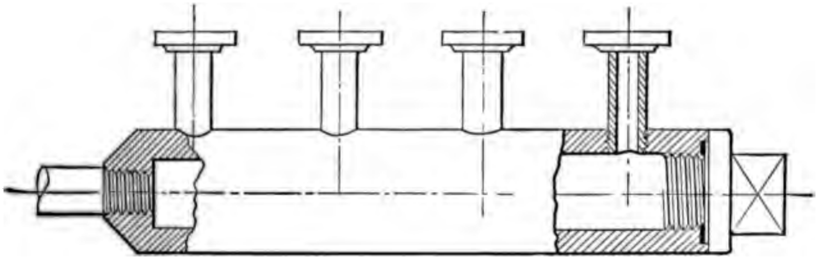
Separator Tank.

Ammonia Gas Strainer.

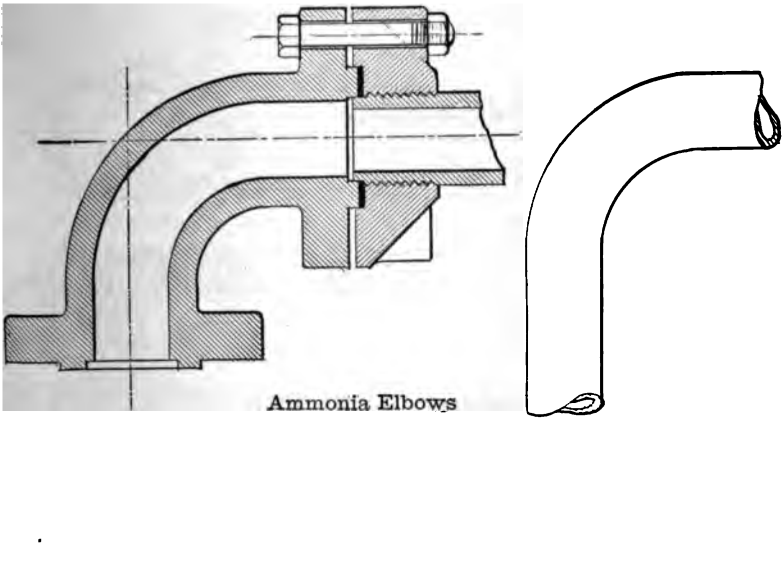
AMMONIA FITTINGS.



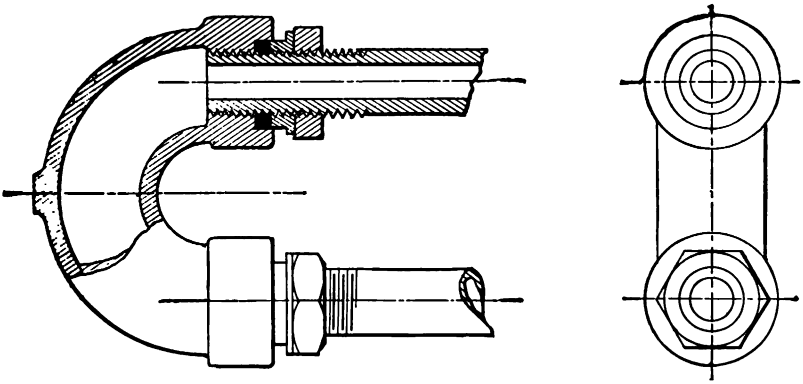
Section of Large and Small Couplings.



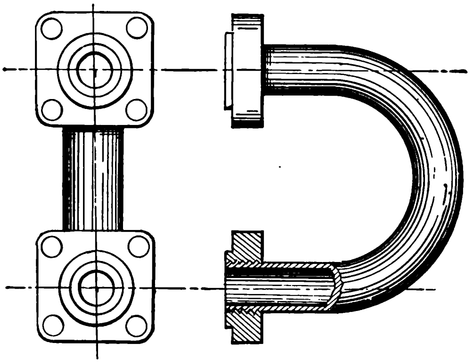
Direct Expansion Suction Gas Header or Accumulator



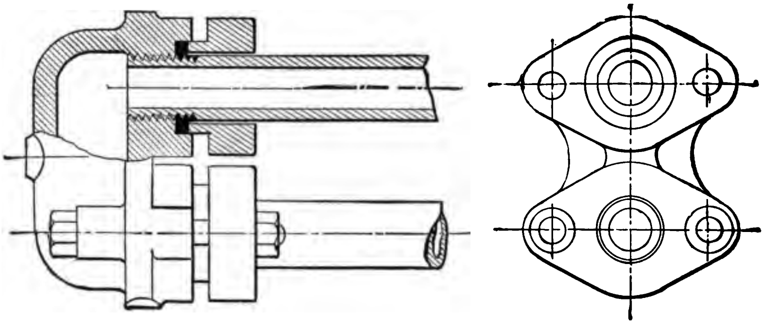
Ammonia Elbows



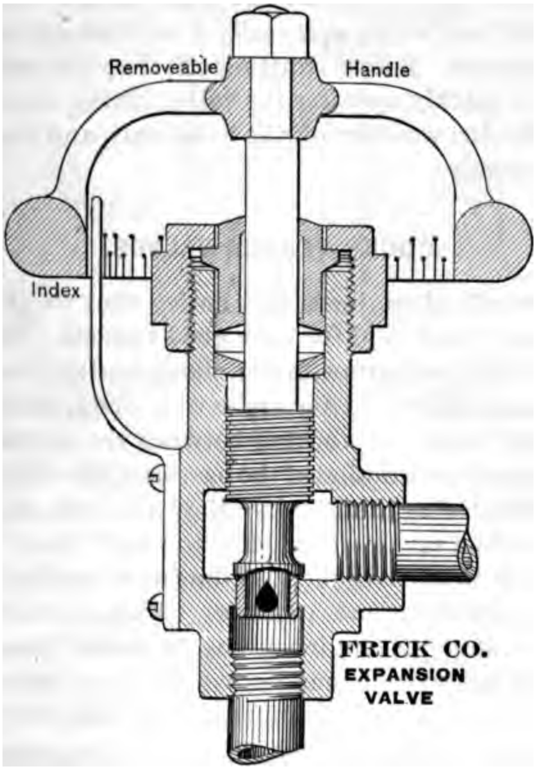
Section of Evaporating Coil Bends.



Direct Expansion Bends



Section of Condenser Bend



Patent Straightway Steel Expansion Valve.

AMMONIA EXPANSION VALVE.

The requirements of a first-class expansion valve are as follows:

1st. Easy and minute adjustment.

2d. Non-liability to clog and easily cleansed of dirt before closing on its seat.

3d. Must be perfectly tight when closed and possess an index and pointer, so the amount of opening is ascertained and similar adjustments can be made as have been by trial ascertained to best suit each case.

The above valve is made of steel throughout and fills all the above requirements perfectly. The expansion of gas is had through the aperture shown in black in the hollow valve stem; and all dirt that can pass through the opening will not lodge, as it easily flows through the rapidly spreading space. Before shutting off, the valve seat may be cleared, by quickly opening the valve, lifting stem clear off the seat, the dirt washing off the bevel seat, and then closing the valve firmly.

COCKS VERSUS VALVES.

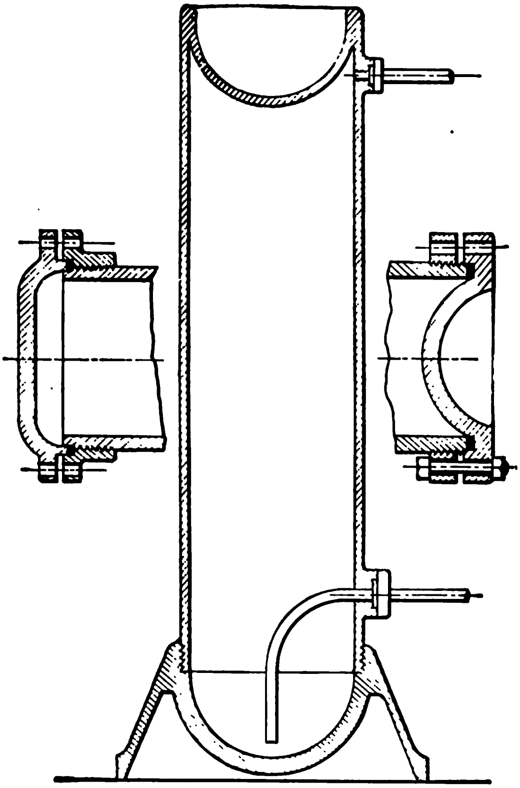
The practical engineer will notice that we do not use cocks of any kind, and for very good reasons. In the first place, cocks are barbarous, crude, cheap, and *were used before valves were invented.* They are hard to open, stick, and are liable to cut from dirt working between the surfaces. The expansion and contraction of the barrels of the cocks changes the form, rendering them leaky; they also leak at each open end, and, when much worn, blow through; they require a long wrench to move them, and the full strength of a man, sometimes two men, and a sledge. When a cock is to be opened or shut the engineer has to spend time looking around for the wrench handle, which is so awkward and clumsy that it is never left on the cock ready for use.

That these cocks are treacherous is recognized by one of the principal users of same on ammonia machinery, who takes the precaution to provide and bolt on each end of the cock a *tight flange cover*, which is a standing advertisement that *cocks are dangerous* and require to be boxed up to make them safe; and safe they are, so long as they are not needed for use. But sometimes the engineer wants to get at the cock in an awful hurry, and then he has to stop to take off the cap, let the residual ammonia pass off, hunt up his wrench, and by that time, he has forgotten what the cock was put there for.

With a valve it is different—always ready, large hand wheel in place, easy to close, easy to open, and in case of accident, safest and most satisfactory of all devices.

Cocks are a relic of the bygone age, and will not do for modern machinery.

AMMONIA STRAINERS OR INTERCEPTORS.



Section of Wrought Iron
Liquid Tank and Joint work

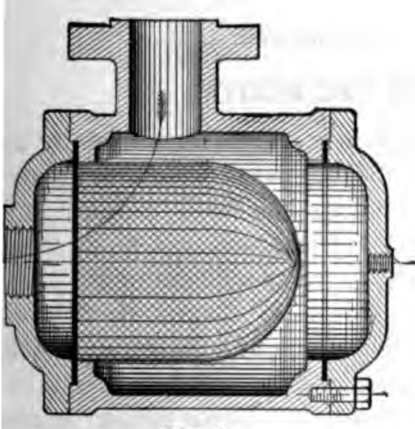


Fig. 1

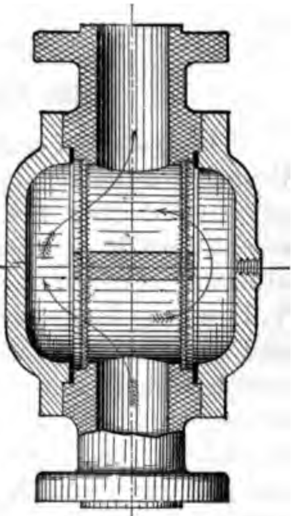
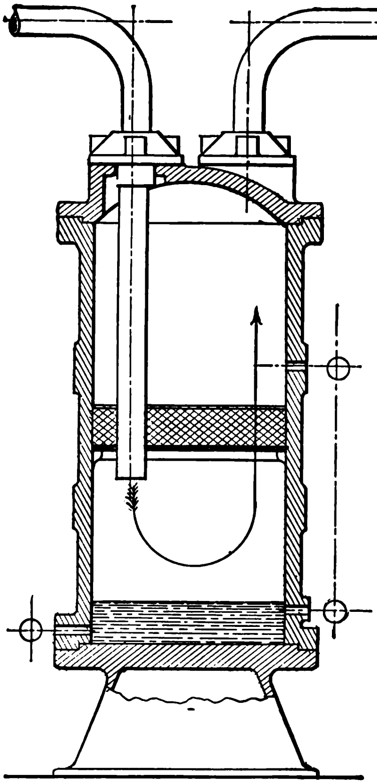


Fig. 2

Ammonia Dirt Interceptors.



Section of large Separator Tank

Made of both Cast and Wrought Iron.

OUR AMMONIA PIPE SYSTEM.

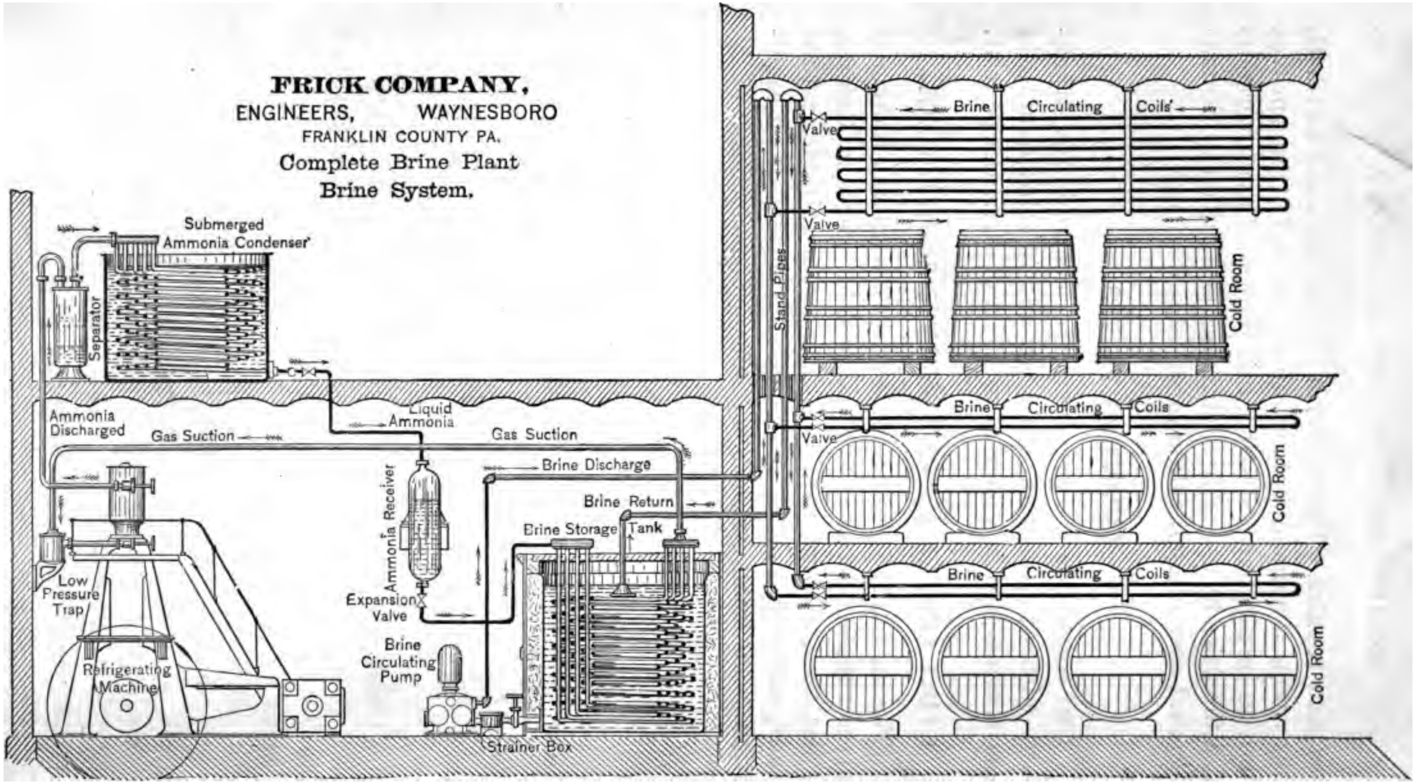
The system of ammonia joints and fittings used by us throughout the apparatus are of the most permanent character; and after the pipe system has been erected and tested there is no opportunity for leakage, and no further attention is required. We use extra special ammonia pipe. Valves are made of drop forgings, forged cast steel and special metal, as are all fittings and fixtures. Each part is tested before leaving our works, and defective ones are rejected. We employ a number of forms for our joints and fittings, each especially adapted to the purpose intended and making a complete line. We have also succeeded in making each part easy of access and removal for examination and repairs. The uniform success we have had with our system of ammonia pipe connections and fittings proves them to be all that is desired, and that we have overcome all difficulties by use of first-class material, good workmanship and correct application of suitable devices.

EXPANSION VALVES.

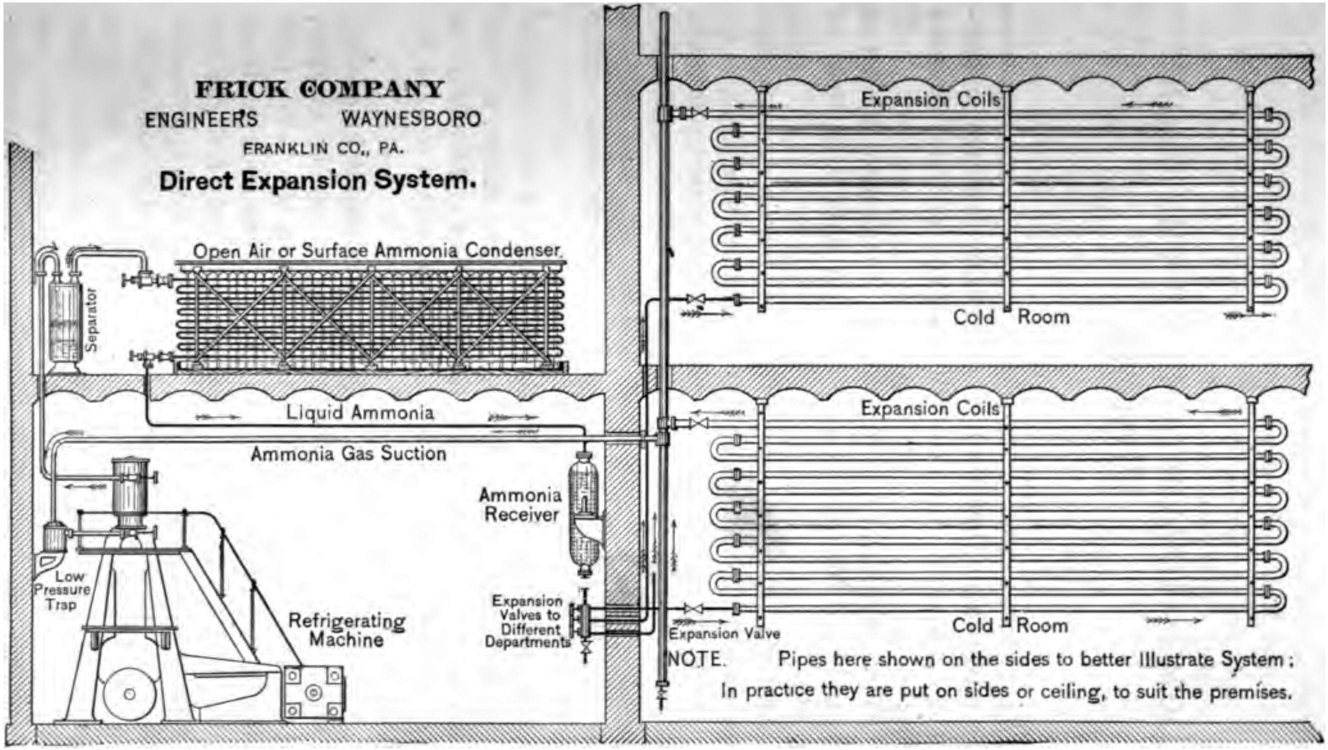
Our expansion valve allows the most minute adjustment without danger of clogging, and is self-cleaning in case of attempted lodgment of particles of dirt. See page 81.

A FULL LINE OF AMMONIA VALVES AND FITTINGS.

We have a full line of angle and straightway ammonia valves ranging from ¼ inch up to 10 inches ; also flanges, valves, tees, elbows, reducers, headers, manifolds, return bands, and solicit orders for the same. Price list on application. All smaller sizes are made of steel forgings.



OUR COMPLETE BRINE PLANT WITH PIPES IN ROOMS.



OUR COMPLETE DIRECT EXPANSION PLANT WITH PIPE COILS IN POSITION.

SOME ADVANTAGES OF THE BRINE SYSTEM.

THE CIRCULATION OF COLD BRINE in the rooms possesses some advantages that are not common to the direct expansion system, and for your information we here present them :—

First. It requires less ammonia to charge the brine system, hence lower first cost for this important item of expense.

Second. There are fewer joints required, therefore fewer chances for leakage and loss of ammonia.

Third. If a leak should occur in the direct ammonia system, in your cold-storage rooms for instance, in many cases life would be endangered, and beer or other material spoiled by the escaping gas, and in most cases the entire charge of ammonia will be lost.

Fourth. In the brine-circulating system a very compact and simple arrangement of machinery and tanks, all contained in the engine room itself, can be had right under the eye of the engineer, making it more convenient to care for and manage.

Fifth. After the machine has been engaged in cooling the large body of brine during the day, it can be stopped, and this reservoir of cold (accumulated in the brine tank during the time machine was in operation) can be circulated by the brine pump during the night with only a slight loss of temperature, thus keeping the rooms and apartments always at the required temperature both day and night, with the machine really running but part of the time. This is the most important economy, as it reduces your coal bill and avoids the expense of night engineer and fireman, and particularly in the case of repairs and adjustments is of special value, besides giving you a large reserve of power. To realize this saving to the fullest extent, put in a machine of ample capacity with large brine tanks.

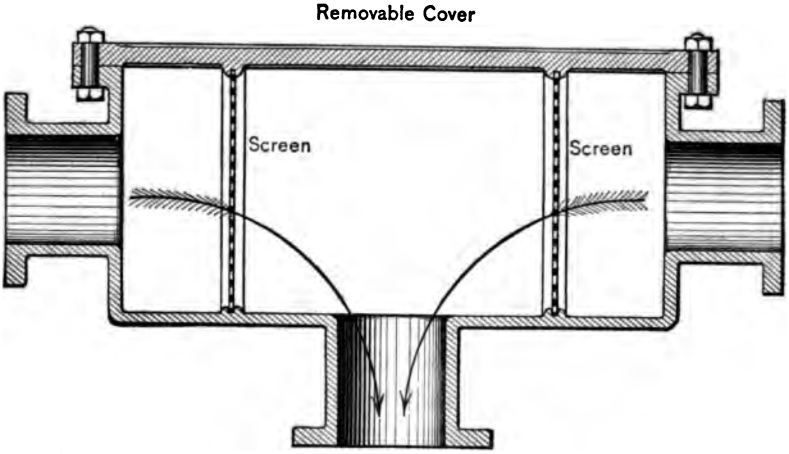
Sixth. In the direct ammonia system, the instant the machine is stopped that instant it ceases to refrigerate, and the apartments being chilled, have then nothing but the frost on the pipes to depend upon for supply of cold; this frost is soon melted and disappears from the pipes and fills the rooms with moisture, and, as a consequence, your rooms become wet and rapidly rise in temperature. To avoid all risk it really necessitates putting in two direct ammonia machines, one of which is held in reserve in case of accident. One machine on the brine-circulating system, when the plant is properly arranged, will be amply safe.

Seventh. There is no marked difference in economy of performance between the direct ammonia and brine-circulating system, as some of the advocates for the exclusive use of direct expansion publish.

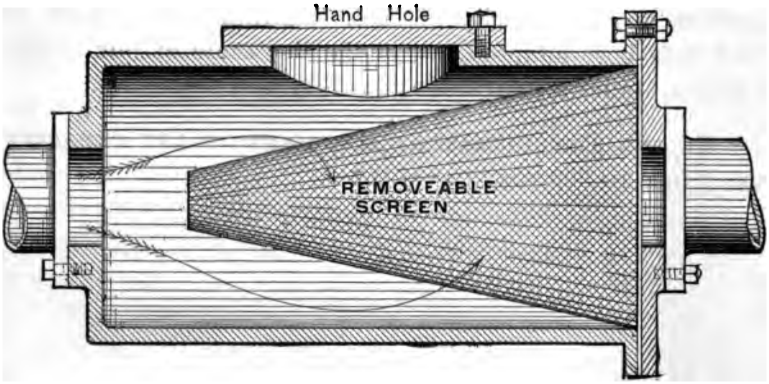
Where customers prefer the DIRECT AMMONIA SYSTEM, or from any peculiarity of their buildings or business we find it is best adapted, we apply the same of our special designs, under a guarantee of safety and efficiency.

SINGLE REFRIGERATING MACHINES OF ANY CAPACITY, FROM ONE TO 300 TONS CAPACITY.

BRINE STRAINERS.



Box Strainer attached to Brine Pump Suction to prevent clogging of Pump Valves.



Direct Brine Strainer for Pump Suction.

THE ERECTION OF OUR ECLIPSE MACHINERY

is in each case according to accurate plans and special drawings made from measurements taken by one of our engineers from the premises. In many cases we furnish the drawings for the buildings to accommodate the machinery. The style of the buildings is made to suit the taste and means of the owner, ranging from a plain wood or brick building to a more pretentious one introducing architectural effects.

We furnish trained and competent mechanics to superintend assembling and installation of each plant; and they in turn are under the supervision of one of our Refrigerating engineers, who regularly inspects the work while in progress.

In all cases we require purchaser to furnish an intelligent mechanic or operating engineer to assist during the erection and testing of apparatus, in order that he may become qualified to take charge after our representatives have left the plant.

The erection, care and management of a Refrigerating or Ice Making plant calls for the highest class of mechanics, and we have a competent corps of such men.

BRINE OR DIRECT CIRCULATING PIPE WORK.

To make the proper allowance and arrangement of the circulating pipes in rooms to be cooled is an important function of the Refrigerating engineer, and should not be entrusted to those not skilled in the business. Many plants that would otherwise have been successful have been saddled with an inferior system of pipe-work distribution, because incompetent persons were allowed to plan and erect the pipe work. In all cases where we guarantee results, we insist that our plans shall be followed and the pipe job subject to our inspection and approval. We prefer, however, to do this work ourselves, as one department of our works is especially fitted for this purpose, with an organized body of skilled workmen for erecting the material on the premises. All our pipe work is carefully tested and planned to suit the premises, from careful measurements by one of our experts in this department. It is needless to add that we use only the best materials, and for our own interest make a special study of the best system of circulation and distribution possible in any given case, for either direct expansion or brine circulation, with or without disks. We have perfected and introduced a novel and complete system of cooling pipes, especially adapted for the various establishments using mechanical refrigeration.

TRICKS OF THE TRADE IN PIPE WORK.

Some of our competitors that have been struck with the mania of low prices we find trying to make *both ends meet* by putting up cheap pipe work, supplying poor pipe, miserable hangers to support same to the ceilings, and in many cases, when their pipes have been well frosted or loaded with ice, as all cooling pipes will (and provision should always be made to support it), down comes the pipe in a wreck on top of the beer tubs or cold storage, breaking the main connections and letting the brine run to waste from the main brine tank, making a sorry mess of it and causes lots of damage. Think of the result if a direct expansion pipe coil should break away in this manner and fill the room with a full charge of ammonia gas! This has happened on occasions. To further cheapen their pipe work, they put in a small allowance of pipe coils, which either fails to do the work or requires to run the brine pump at a high speed to force a large amount of brine through inadequate coil surface to obtain results. This trick may not seem clear to you. We explain that it is simply a question of the number of pounds of brine pumped into a room to be refrigerated, per hour, to do a given amount of cooling. If you have but one-half the pipe surface, the brine must travel at double the velocity to pass the required quantity into the room in a given time; and this is not all, each square foot of pipe surface will transmit or conduct to the brine just so much heat, and time of contact is an element; and further, the larger the body of brine contained in the coils of any given room and the longer in transit, the less the friction in moving it and the more effective the cooling surface, and the greater the possible range of temperature between the outgoing and return brine. When the pipe surface is reduced beyond a certain point, the brine has to be made very much colder (which is not economy) in order to create a greater difference of temperature between the inside and outside of pipe, that it may take up the required heat. The transmitting efficiency of iron pipe increases as the difference in temperature, without regard to time. Again, an inadequate amount of pipe surface will not allow a raise of temperature in brine tank without the rooms thus insufficiently piped becoming too warm, no matter how fast the brine pump is run. Another trick, and a shabby one it is, where the brine coils are connected to the feeding mains, is, instead of using a heavy substantial fitting, *to deliberately tap into the thin shell of the main* and screw pipes therein, necessitating in the near future the entire overhauling of all such joints and supplying proper fittings—a great expense.

The above tricks and others, we are sorry to say, were and are practised by some Refrigerating companies, who have no other excuse than they want to sell cheap.

CHAPTER V.

COMPARISON BETWEEN COMPRESSORS USING "OIL" AND THOSE THAT USE "NO OIL," OR "OIL" VERSUS "NO OIL."

THE TROUBLES AND DEFECTS OF THE OIL SYSTEM.

HOW WE DO IT.

A HISTORY OF THE OIL SYSTEM, AND WHY A BIG COMPRESSOR MUST BE USED TO OFFSET THE WORK DONE BY A SMALLER ECLIPSE MACHINE.

LARGE REFRIGERATING MACHINES. WE HAVE MADE THE LARGEST EVER PRODUCED IN THIS OR ANY OTHER COUNTRY.

OIL VERSUS NO OIL SYSTEM OF COMPRESSION.

Our ECLIPSE COMPRESSOR PUMP is so constructed that it perfectly *receives* and *expels* the *full charge of gas* without resorting to the use of oil to take up clearance space. No compressor can do more than this, while many do less, owing to bad workmanship, false adjustment and faulty design.

The maximum pounds of gas pumped for the minimum pounds of steam used in the engine of an ice machine is the real index of pump economy. As you learned in reading the chapter on Theory and Practice of Refrigeration, each pound of *dry gas* passed through the compressors is capable of doing a definite amount of refrigeration, and this amount per each pound of pure gas so expelled is the same with either the " OIL " or the " NO OIL " system. Oil does no work ; it is a " detrimental," a hindrance.

HOW THE OIL CAME TO BE USED IN GAS COMPRESSORS is easy enough to understand, but why its use is continued at this late day when competent designers, first-class machine tools that will do true work, proper materials of construction and expert workmen can be had, *is not* so easy to understand. You must know that *oil was used originally to overcome a defect in the pump*, which was neither more nor less than a leaky piston and a great big vacant space that was left between the end of cylinder and pump valves after the piston had completed its stroke.

We said this was a vacant space, but it was not ; it was really filled with compressed gas, at the condensing pressure, and the result was as follows : Upon the return stroke of the piston, this gas, promptly expanding back to the original pressure at which it flowed into the pump (back pressure), effectually prevented the reception of an amount of gas equal to its own volume after re-expansion, amounting to from ten to fifteen times the waste space; hence it will not surprise you to learn that the pump *was not* a success. Now, what was to be done? Some one suggested, "*Squirt in oil,*" to fill up the waste space, he having in mind, no doubt, the somewhat similar use of water in air compressor (maybe they tried water first). Oil *was* used, and presto, change! the pump *really* began to expel gas. A small pump was then applied to insure a regular supply, and then the fun began—to handle the oil. First, a good deal of oil had to be used, because the space was big; second, when the oil was once introduced into the system it could not be gotten rid of without loss, as it was heavily charged with ammonia; third, it got into the pipes and coils and *froze*, choking them up, and by coating with a thin film the inside surfaces of the condensing and evaporating coils, acted as a *non-conductor* and reduced the efficiency of the apparatus, and presently the machinery became inefficient. To help them out of one easily cured trouble into bigger ones, the following was introduced and are unnecessary and complicated additions to our system, which is at once efficient and simple:

First. A means to adjust and supply the oil to the compressors.

Second. A separator to separate the mixed oil and gas as it is discharged from the compressor pumps.

Third. One separator was not enough, and a second was added.

Fourth. A cooling apparatus to cool the oil, in order to use it over and over again.

Fifth. Regulating tank for storage of oil.

Sixth. A complicated system of oil pipes, valves, pumps and oil-regulating apparatus.

Seventh. With all this, the oil *will* occasionally escape into the evaporating coils and freeze there, and special drip and large return tanks are provided to catch it at the lowest point in the system. Now the "oil" system is equipped, and brains must be cudgeled to make a *virtue* of necessity. Well, says one, "*It lubricates the piston and pumps anyhow.*" The second says, "*It may act as a plug to prevent the leak past the piston and stuffing box.*" (A poor apology for bad workmanship.) The third says, "*I think it will carry off a little of the heat of compression.*" "Aha! I see; *cooling, sealing and lubricating fluid.*" Now for business.

A HISTORY.

The experienced "no oil" system men, longer in the business by far, correctly analyzed this innovation and predicted developments, which came in this order:

First. The oil was found to *freeze* in the pump on the suction side when machine was pushed, and began to frost back.

Second. A brilliant scheme was concocted to avoid this calamity by running the *main suction gas pipe over the condenser coils in such position that the water used on condenser* would flow over this pipe and thus carry off the frost and prevent freezing back (a rob Peter to pay Paul affair). Again a virtue of necessity and a declaration that this "*increased the efficiency of the apparatus.*" This has been changed or abandoned as worse than useless.

Third. It was found that between the two extremes of intense cold of the return gas on the suction side and the hot compressed gas on discharge side, that the oil had a hard time of it, and that no oil would stand this double treatment. *It would freeze if too heavy and vaporize if too light;* the oil vapor passing over with the gas into the condenser and evaporating coils. Again a virtue of necessity and a selection of oil that had the greatest range. A claim, "*We have discovered a new liquid base.*" (A base fabrication.)

Fourth. It was found that a *check valve* had to be used in the main suction pipe to prevent the oil from being carried back into the evaporating coils. (Then they would fill up at both ends.) We never found it necessary to use such a valve, but then we don't use "oil." Again a virtue of necessity; the check valve is a good thing because, because—well, because! (*they can't get along without it*).

Fifth. It was found that the piston of the "oil" compressor, bringing up on the solid abutment of oil, reduced the problem to the simple one peculiar to all pumps "handling fluids," that is to say, such pumps, to prevent undue shock and jar, have to run slow; also to allow time for the oil to be introduced, and prevent spraying into particles by velocity of the discharge current into such a fine mechanical subdivision that it became mechanically mixed with gas; further complicating the problem of separation to prevent the entrained oil from passing into and permeating the entire system.

Sixth. It was found that gas would not readily flow into the pumps against the resistance of the check valves and dense body of chilled oil, the flow being impeded to such an extent that time had to be allowed pump to fill with gas, except by keeping speed of machine ridiculously slow. Practical tests have demonstrated the inferiority of an "oil" laden pump to handle gas with the same facility as a "no oil" pump. This is also shown when an attempt is made to exhaust the contents of the evaporating coils; the "oil" compressor requiring one hour and then fails to secure a vacuum; ours but five to eight minutes.

The *slow speed* of the oil compresses is criticised by engineers and shown to be bad practice and *poor* steam economy.

Again a virtue of necessity, and it was given out that a slow speed machine "would never wear out," but this is a big mistake; it will wear and sometimes has hot bearings.

Seventh. It was found that the residuum of oil left in the clearance space and hence not discharged from the pumps, led to a similar loss to that of excessive clearance, from the fact that the oil became *saturated with gas under compression*, and when the pressure was released on the down stroke the gas re-expanded out of the oil, preventing the reception of a full charge. This was recognized after a while, and an able expert, experienced in the system, has

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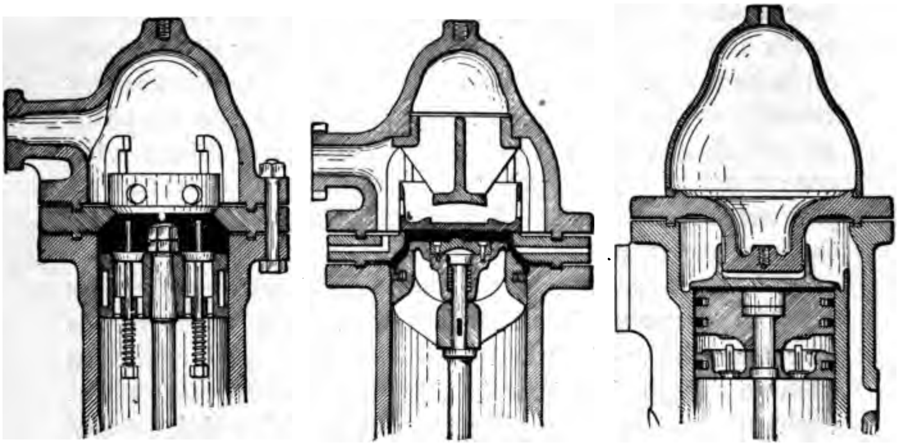
testified that the loss amounted to over 40 per cent from this cause alone. This necessitated a change in the method of introducing oil which shows a slight improvement; and further advance can only be made by abandoning oil entirely.



1883. 1887. 1890.

PROGRESSIVE IMPROVEMENTS MADE BY THE LEADING OIL SYSTEM, WASTE SPACE FILLED WITH OIL SHOWN IN BLACK.

Eighth. It is gratifying to record that the "oil" system advocates from year to year have been *making improvements,* as shown above, and coming constantly nearer the practice of our "no oil" system by reducing the clearance in the pump, using less oil, and abandoning high condensers, thus tumbling from the proud position of leaders to imitators, etc.

Ninth. It is amusing to see the deceit practised by the "oil" system men when they instituted a comparison between the "oil" compressors and "no oil" compressors. *Mind you, they carried out both experiments on their own machine,* with "oil" and without "oil." *Think of it!* that large waste space of their 1883 pump filled with compressed gas to expand back, and to gravely publish that it represented the real difference between the oil system and the perfect expulsion of our compressors. Why they did not

secure a perfect " no oil " pump such as ours to experiment with and thus arrive at the truth by actual performance, can only be accounted for as a bad case of self-deception.

Tenth. It has been represented that the "oil" system machine *can be actually run faster;* but, alas! they still have to use a big pump or equivalent displacement; it is also found that increase of speed *only slightly* increases the amount of work. With our "no oil" system we have found, on the contrary, that *increase of speed means proportionate increase of work.*

COOLING, SEALING AND LUBRICATING

with our Eclipse "no oil" system is done as follows: *Cooling,* during compression, by the water jacket surrounding pumps. *Sealing,* by adopting a suitable piston and stuffing box. *Lubricating,* ample for all requirements, from the ammonia itself, and a few drops of oil in the piston rod stuffing box only at intervals by a sight feed lubricator.

SLOW SPEED IS BAD STEAM ECONOMY.

The approved practice in modern steam engineering and best results are obtained at a fair piston speed and moderately quick rotation, and you will please note that our compressors are *handling a perfectly elastic gas,* which will respond and fill a properly constructed pump fitted with our valves faster than there is any occasion to run a compressor. Really there is no limitation, except a structural one, restricting the adoption of any required speed to secure the highest duty. All that is needed is a properly designed machine, that is perfectly *adapted to* the speed selected; and practice proves that there is no more wear and tear on this than a slow-speed machine or a first-class steam engine.

FRICTION OF REFRIGERATING MACHINES.

It is found that a first-class "no oil" system machine such as ours will convert within less than twenty per cent all the power developed by its engine into actual work of the compressors. This efficiency has not been equaled by the "oil" system, and disposes of their claim that friction is reduced by slow speed and so-called cooling, sealing and lubrication.

COMPARATIVE MERITS OF THE TWO SYSTEMS.

As the problem is reduced to the handling of a given number of pounds of gas between a certain range of temperatures to do the largest amount of refrigerating work therewith, we have arrived at the highest efficiency with the simplest apparatus without deceiving ourselves with the idea that *mixing the pure anhydrous gas with anything foreign to itself* will increase the economy of our apparatus. Take for instance two compressors, one "oil" and the other "no oil," of the same number of cubic inches displacement of the space swept by piston per stroke, both of the best makes and conditions being equal, it will be found that the "oil" pump does not receive or discharge as much gas per stroke as the "no oil" pump, and this will establish the relative value of the two systems. But we go farther: The gas handled in the "no oil" system is pure anhydrous gas, and the "oil" system is not, being mixed with oil which further reduces the efficiency. Our "no oil" system has no complicated and expensive separating apparatus, which the "oil" system *must have to work at all.*

BACK PRESSURES.

A false point is made that the "oil" system and direct expansion can be run at an increased back pressure, hence do more work by reason of handling more gas per stroke owing to the increased density of gas at the higher pressures. Let us say, for the information of the reader, that the amount of back pressure obtainable has nothing whatever to do with "oil" or "no oil" in the system, but is fixed by the conditions of work and the relative amount of *heating surface* in the evaporating coils, either direct or brine.

YOU CAN'T DO SOMETHING FOR NOTHING.

This is a homely phrase, but it means a good deal. If it were not for the fact that the laws of thermodynamics (relations of heat and work) and the mechanical equivalent of heat were at this late day so well defined, it might be easy to say and support by false reasoning, without detection, that certain benefits may be secured without giving *something* in return. We refer to the idea advanced by the "oil" men that they can secure lower temperatures, especially in direct expansion practice, than "no oil" compressor, *without cost.* They ignore the law of conservation of energy and are confused by their own reasoning.

LARGE REFRIGERATING MACHINES.

We have produced several of the *largest Refrigerating Machines ever built in this or any other country, and they have been eminently successful.* No other concerns so far, in this line of business, have dared to attempt building machines so large, perhaps because they are incompetent or afraid; but in any event because they have not the experience and proper equipment to do such heavy work. We have also built the smallest machines, and our patterns cover all sizes now shown in our list.

They may tell you, as an excuse for not being able to supply such large machinery as is now being called for in the more extensive Cold Storage Packing Houses, Breweries and Ice Factories, that several small machines are better than one or more large ones; but this is proved to be neither economy nor common sense.

Some of our competitors make a double-acting machine *out of their former single-acting patterns.* It is bad enough to adopt a double-acting pump with special new patterns, but not to do so where coupled with the fact that the strains are doubled and the same patterns used, is a humiliating example of bad engineering.

If we should resort to this *trick* for no other reason than to make a *cheap machine* without regard to efficiency and durability, and thus recklessly abandon a good system for an inferior one, we certainly would deserve the suspicions of the trade; that our standard of excellence had been trailed in the dust, and that we were living upon our past reputation.

We will furnish, when plants are of sufficient magnitude to justify their use, *single-acting Machines of* 300-*tons refrigerating capacity.*

If we should resort to the bad practice of making our *single-acting machines double-acting* JUST TO SELL CHEAP, our competitors would rate our largest machine 600-tons capacity; and as our patterns are *double the strength of any in the market,* we could do so and still have a large margin of safety. Please bear this trick in mind, and insist upon the Vertical Single-Acting Compressors, whether you buy from us or some one else, and have done once for all with the old and always to be unsuccessful experiment of the double-acting gas compressor.

CHAPTER VI.

MECHANICAL REFRIGERATION.

HOW TO MAKE LOW PRICES—"HERE TO-DAY AND *GONE* TO-MORROW."

ABSORPTION SYSTEM.

ITS HISTORY AND ITS TROUBLES.

ITS DEFECTS AND TROUBLES—WHY IT USES MORE WATER, TAKES MORE COAL AND DOES LESS WORK THAN OUR COMPRESSION MACHINE.

ILLUSTRATION OF A LEADING ABSORPTION SYSTEM.

MECHANICAL REFRIGERATION.

The early attempts at Artificial Refrigeration date back to a much earlier period than most people are aware, but it is only within the past few years that competent engineers have become interested and fully developed the art by making so many practical improvements that it has now come into extensive use.

COMPRESSION SYSTEM.

It is not our purpose to devote space to a résumé of the processes and patents of earlier inventions further than to say that the system in most extensive practical use, and in all cases the most successful, is the one we employ, viz. MECHANICAL COMPRESSION, using Anhydrous Ammonia as the agent.

ABSORPTION SYSTEM.

Another plan, called the ABSORPTION SYSTEM, has been the subject of exhaustive experimentation, and has in practice proved not to be so economical or efficient as Mechanical Compression—a weary record of wrecks, failures and scrap heaps being the legacy left to customers, with little future prospects of overcoming the natural difficulties that present themselves in this scheme. Full investigation and a correct understanding of the reasons for the inefficiency and failures of the Absorption System ought to discourage most men from spending money in this direction, but the scheme appears so inviting that a class of inventors and investors are found who are unable to resist its fascinations, hence it continues to find its advocates.

COMPRESSION SYSTEM,

since it has occupied the attention of competent engineers, has had a remarkable series of successes, the original failures arising from a lack of mechanical ability to design and properly construct the various details of the machinery; the fact that it was the only correct system having all along been appreciated.

This brings us to the point we wish to make: The Designing and Manufacture of Refrigerating plants is best carried on by the concerns who make a specialty of the business, and, by reason of their large facilities and broad general experience, have established a system at once efficient and uniformly satisfactory.

The practice and theory involved in Mechanical Refrigeration may seem at first sight hardly in the line of Steam Engineering, but, as a matter of fact, it really is encompassed by it, and the proper adaptation and arrangement of the plants of the intricate and expensive apparatus to obtain the highest efficiency is best done by those having a general engineering experience.

In support of these facts we have mentioned that the failures of early days were because of inexperience as engineers, and not from lack of knowledge of the theory and principle of Refrigeration. If these men had been better practical mechanics and poorer philosophers, then we would have had no failures to record.

A modern first-class Refrigerating plant consists of an assemblage of parts familiar to most mechanics, but only when grouped and carefully arranged by an engineer specialist will the longest life and best results be secured. The work must be properly done, of suitable materials, and each detail adapted to the special purpose for which it is used.

With a thorough understanding of the business, and being able to build by means of special machinery the largest machine yet produced, and with our own system of Refrigeration perfected, we do not hesitate to compete with any builder in the market, and solicit a strict comparison and actual test.

We build Refrigerating machinery to do the work we guarantee it to do, and make no attempt to cheapen at the expense of economy and durability.

WRINKLES OF THE CHEAP MANUFACTURERS, OR HOW TO MAKE LOW PRICES.

1st. A small machine run at high speed.

2d. Driven by the cheapest kind of an engine, wasteful of fuel, and as small as possible to make the shaft go around.

3d. A light weight machine that will wriggle and twist and loosen all its joints and have hot bearings.

4th. Use of common pipe instead of extra strong pipe for all ammonia work.

5th. The cheapest kind of cocks and fittings, common every-day affairs; anything that will do temporarily.

6th. Cut down on the condensing surface and furnish a small condenser.

7th. Cut down on the evaporating coils in brine tank and use common thin pipe.

8th. Use a small brine tank made of the lightest possible iron; anything that will hold water, especially if joints are temporarily stopped with putty and paint.

9th. Rob the system of every valve and fitting that can be spared, no matter how convenient it may be to have them and how much they may be needed during the season. The engineer will find *some way* to get along and make repairs, even if he has to break a joint and *blow the full charge of ammonia in the air.*

10th. Use small suction and discharge pipes.

11th. Use small separators and traps, or do without them.

12th. Small brine pumps, not brass lined, and no brine strainers.

13th. Insulate brine tanks with sawdust and cheap pine flooring.

14th. Cheap brass oil cups and lubricators on the engine.

15th. Cast iron in the place of wrought iron, wrought iron in the place of steel, lead in the place of genuine Babbitt metal; and cheap brass in the place of phosphor bronze.

16th. Word your contract so when it comes to the pinch your customer has to furnish a good many things he thought the contractor was to supply because they were not specifically designated.

17th. Small boiler power and cheapest kind of belongings.

18th. In ice plants a small allowance of ice moulds of thin iron.

19th. A deficient and cheap distilling apparatus not galvanized.

20th. One thing of a kind where two ought to be used.

21st. Patch things up so they will pass for the time being.

22d. Get along without fittings by boring holes and tapping into the thin pipe mains for all branches.

23d. Put the job up anyhow, and use light hangers that will pull down when the load of ice comes on them—on the "here to-day" and "gone to-morrow" plan.

24th. Use a double-acting compressor, and the latest wrinkle is to make double-acting pumps out of your old single-acting patterns, keeping pumps same size, thereby trying to make a machine of half the weight do double the work.

25th. Another common way to make low prices is to be careless in estimating the cost of details and erecting expenses, "guess at everything," and to be in blissful ignorance of what details actually cost you, and what you have to pay for materials in market; say: "I think this will cost so much," "Put it down so," "I'll risk it," etc.

We don't pretend to say that any of our competitors do these things; but we do know by actual figures that what is being sold as a first-class plant is and has been equipped on this plan, much to the sorrow of the purchasers, who had to pay for expensive repairs and changes.

THIS IS WHERE GOOD JUDGMENT COMES IN.

All of the above items put together on an ice or refrigerating plant will cheapen the cost from 15 to 33⅓ per cent., and it is only by such tricks that first-class concerns can be undersold, and we would further state that it does not pay to cheapen this class of machinery, except by fair and legitimate means, such as improved process of manufacturing and to buying materials in large quantities.

HISTORY OF ABSORPTION SYSTEM.

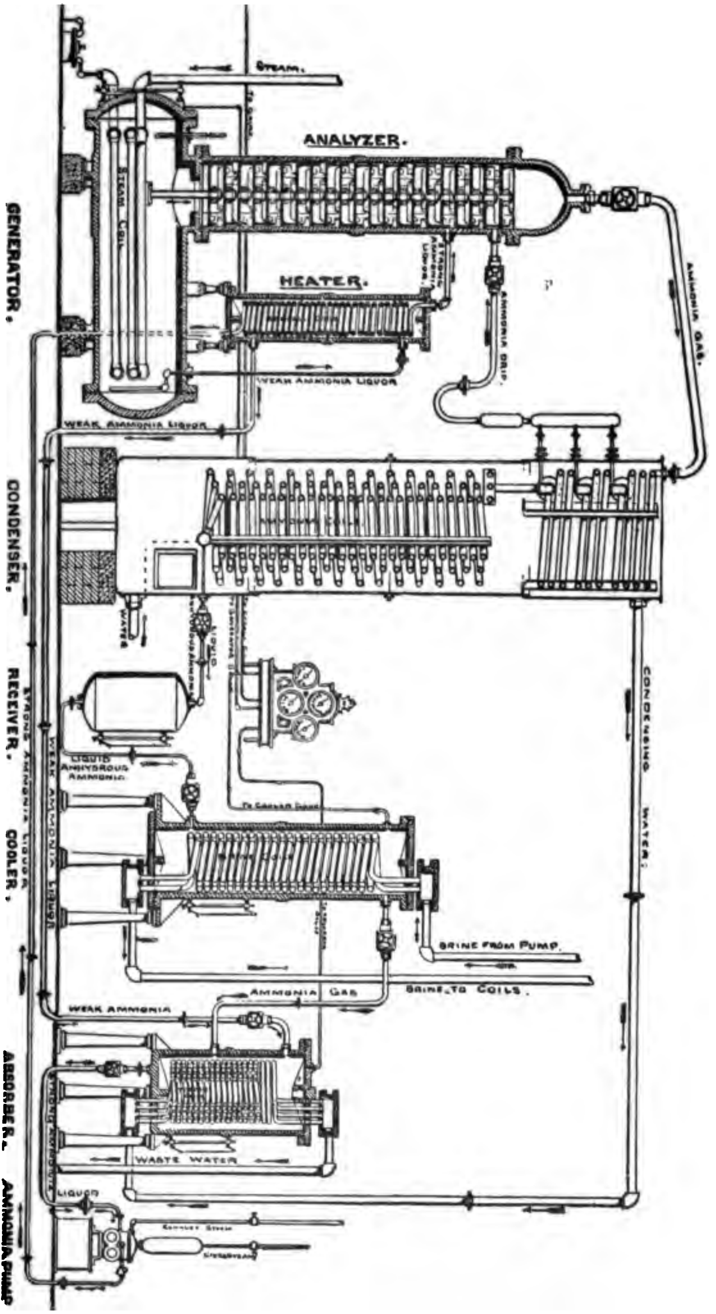
The absorption system was first introduced by a Frenchman by the name of Carre, whose great skill and ingenuity enabled him to quickly develop the scheme, and place it upon the market in its most perfect form. Its defects were soon practically demonstrated, and it was practically abandoned, but again taken up in this country. Notwithstanding the great number of absorption machines tried from time to time, none have succeeded in improving, except in small details and use of better materials and workmanship, upon the original Carre, as indeed, owing to his great ability, was to be expected. None of the changes introduced by the imitators of Carre have succeeded in overcoming the inevitable defects or controverting the action of natural laws.

DEFECTS OF THE ABSORPTION SYSTEM.

1st. Rapid deterioration of the coils and boiler plate work in contact with aqua ammonia, which has a peculiar action under the conditions of its use on these parts.

2d. Failure to secure a dry gas from the still, notwithstanding the use of complicated drying chambers, the vapors passing from the generators being saturated with steam from the water, which, passing along with the gas into condenser, is therein condensed, accumulates and reabsorbs the ammonia in large quantities, entailing a considerable loss of efficiency and waste of fuel.

3d. An occasional violent foaming or priming of the contents of the still into the condenser (especially if the engineer is caught napping and allows his steam pressure to vary), which destroys the action of the apparatus for a time, and necessitates frequent blowing out the condensers or the use of bye pass or drip pipes.



Sectional View of a leading Absorption System.

4th. Large amount of fuel required for boiling off the ammonia from the aqua solution ; in other words, destroying the affinity of water for ammonia and latent heat of evaporation, besides uselessly heating the water and converting a portion of same into vapor. Comparing the work done in a still, liberating a given number of pounds of gas from the aqua into the condenser, with a mechanical compressor discharging the same quantity of pure anhydrous gas, the proportions are shown by calculations and confirmed by practice to be nearly as 1 to $1\frac{6}{10}$, that is to say that an Absorption machine will use 16 tons of fuel where our Mechanical Compressor will use 10 to do the same work.

5th. Difficulty in securing regular action of the apparatus, owing to incessant adjustment of valves controlling flow of liquor and gas to suit the ever-changing conditions of temperature, work and pressure, it being necessary that the engineer be on the *qui vive* at all times and, like a train dispatcher on a trunk line, at his post with strained nerves and quick action.

6th. Losses of ammonia due to development of leaks in the submerged coils and joints.

7th. Amount of water required for condensing, cooling weak liquor and absorbing. This triple demand makes it necessary to use from 5 to 6 gallons per minute, when our dry gas system uses but two gallons.

Absorption system will not work at all where water is of very high temperature, and in any event, high or low, unless the supply is three times as great as mechanical system.

Loss of efficiency, feeble work, or downright failure, where water rises in temperature in midsummer, owing to having to work at higher condensing pressure ; and not being able to cool weak liquor sufficiently to absorb its proportion of gas prior to return to generator.

8th. It scarcely need be said that where much water is used to cool gases and liquors, much fuel must have to be expended to previously heat them. A corroboration of this is found in the fact that all absorption machines when making ice waste about 50 per cent more condensed steam from the still than is needed to fill the ice cans, while our compression machines fall short about 25 per cent, which amount has to be made up by bleeding the steam boiler.

9th. It is claimed that the Absorption system is cheaper to build, but we would here remark that if they were made as good as they should be, owing to the multiplicity of parts their cost would exceed the Compression system, but cheap as they are sold, their history proves them to be the dearest kind of an investment.

10th. It appears to the ordinary, unskilled observer that Absorption plants are simple; and so they are outwardly, but what a short-lived impression when once their true inwardness and mulish habits are learned!

See also page 32 for previous mention.

CHAPTER VII.

MECHANICAL REFRIGERATION IN BREWERIES.

WHAT IT DOES FOR THEM.

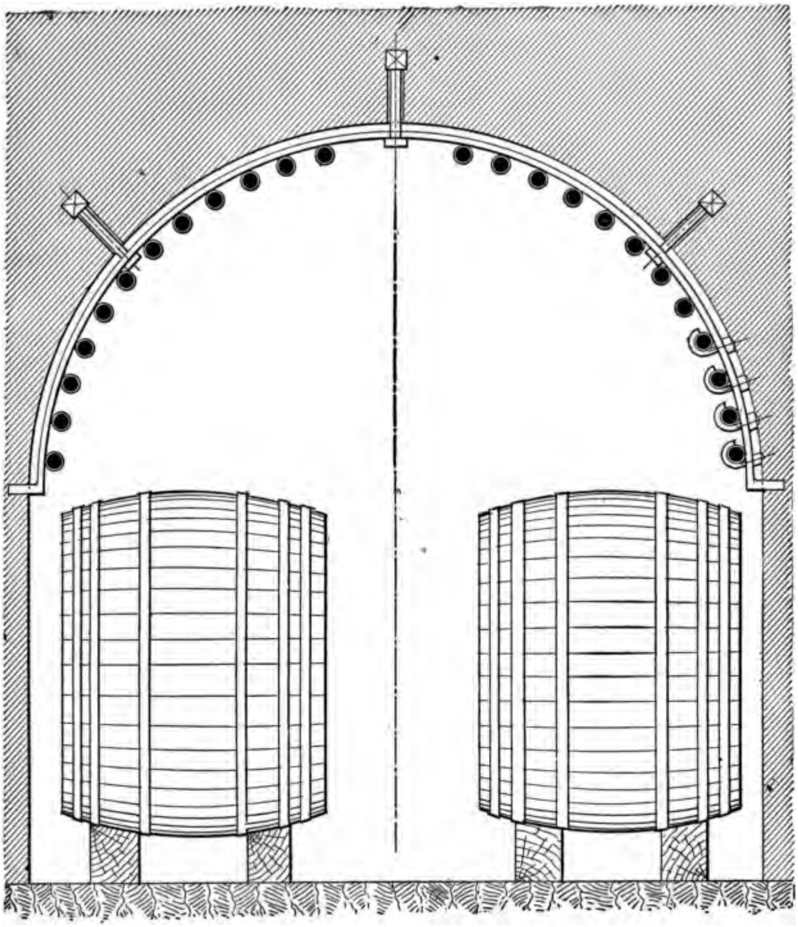
ILLUSTRATIONS OF PIPE-WORK.

FERMENTING ROOMS.

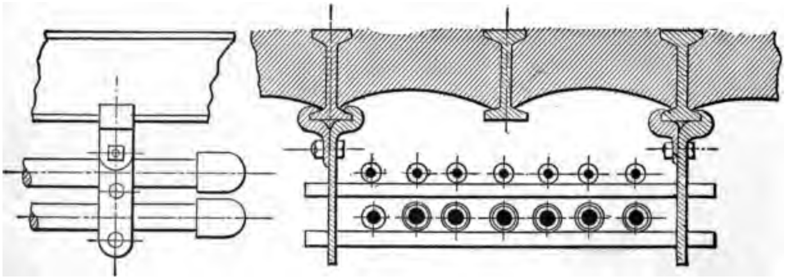
ATTEMPORATOR SYSTEM.

REFERENCES TO BREWERIES USING OUR ECLIPSE MACHINERY.

TESTIMONIALS FROM BREWERS.

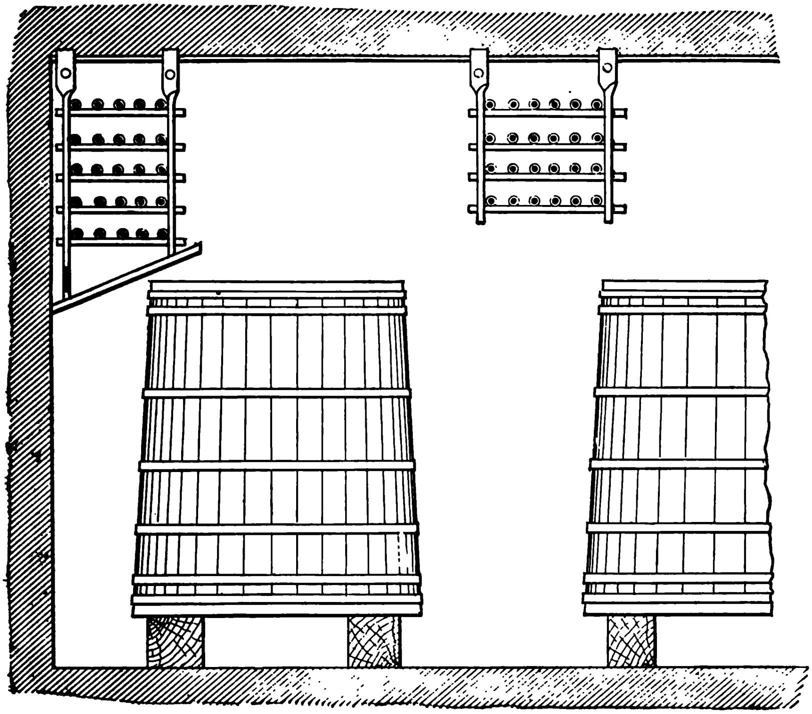


PIPE ARRANGEMENT FOR VAULTS.
Showing method of supporting, from Ceiling.



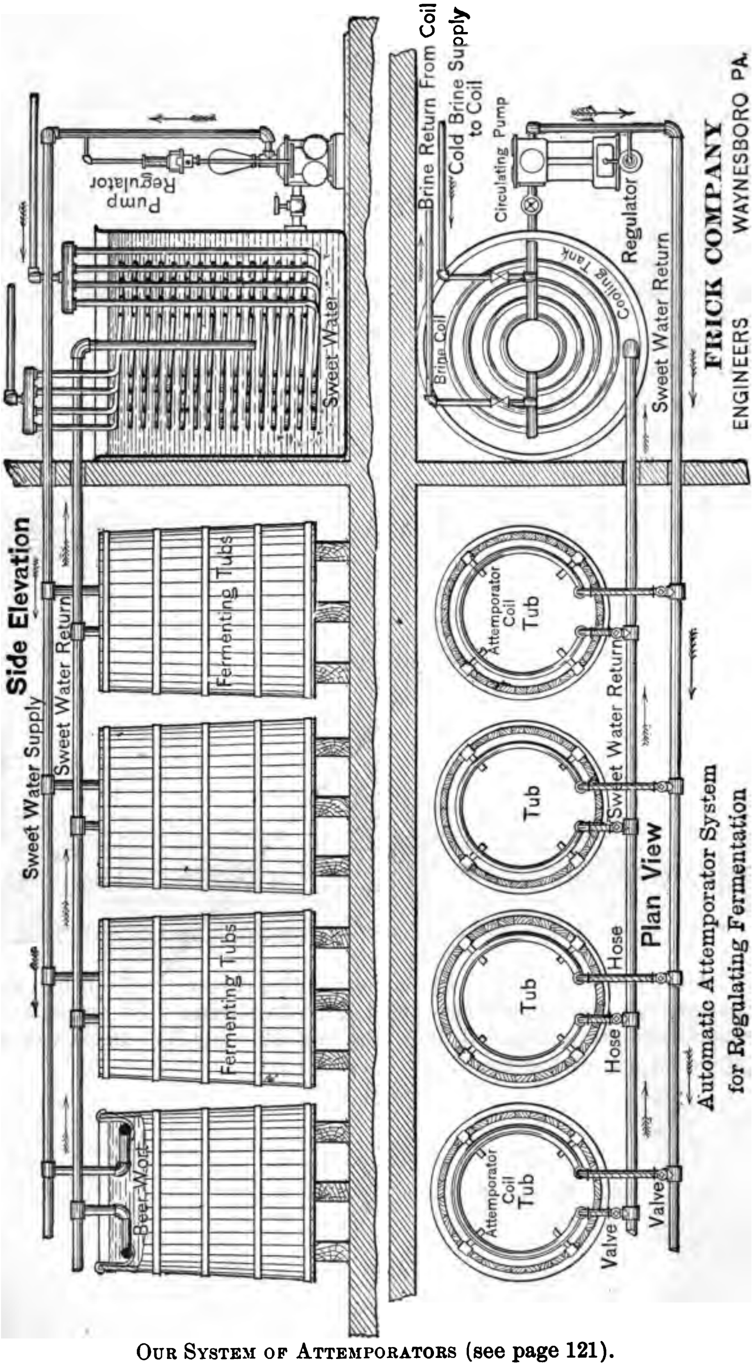
Flat Pipe Coils suspended from Ceiling.
on Iron floor beams, for Storage and Fermenting Room.

FERMENTING ROOM.

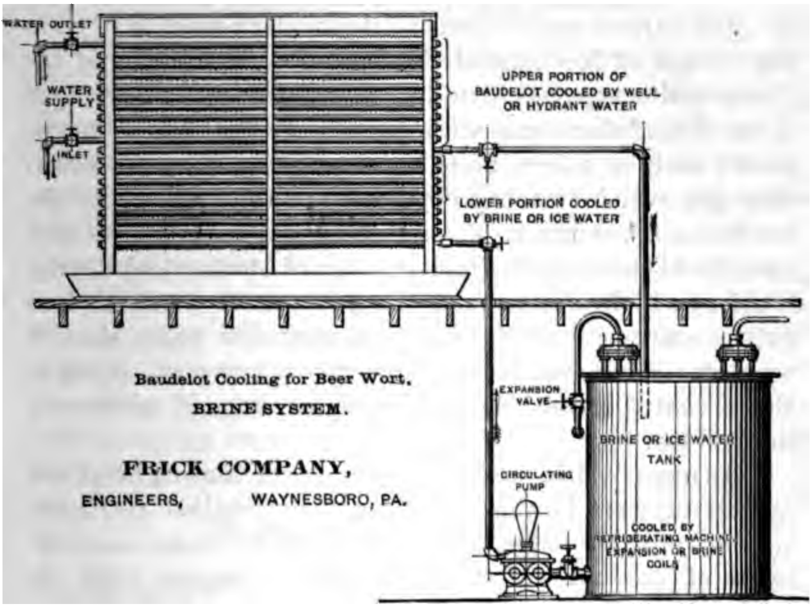


Arrangement of pipe-work in Fermenting Rooms, coils being suspended from iron floor-beams and located in passage-ways and sides of rooms, thus preventing drip into tubs, and affording free access to each tub—a favorite arrangement.

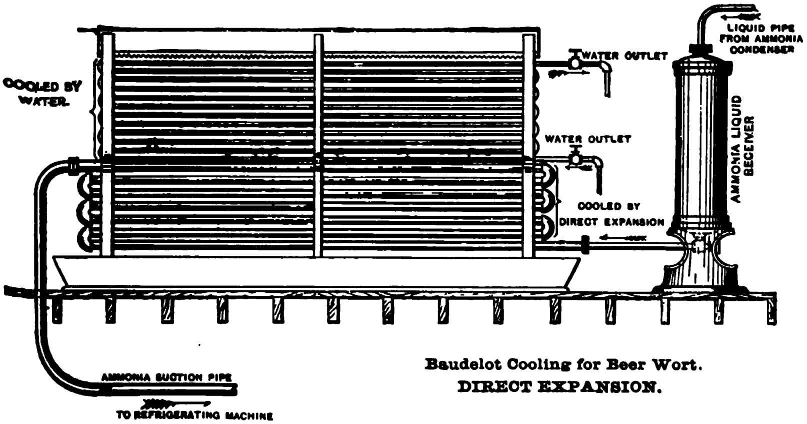
ATTEMPORATOR SYSTEM.



Our System of Attemporators (see page 121).


WATER OUTLET
WATER SUPPLY
INLET
UPPER PORTION OF BAUDELOT COOLED BY WELL OR HYDRANT WATER
LOWER PORTION COOLED BY BRINE OR ICE WATER
Baudelot Cooling for Beer Wort.
BRINE SYSTEM.
FRICK COMPANY,
ENGINEERS, WAYNESBORO, PA.
EXPANSION VALVE
CIRCULATING PUMP
BRINE OR ICE WATER TANK
COOLED BY REFRIGERATING MACHINE EXPANSION OR BRINE COILS

Brine Baudelot Cooler for Beer Wort. Cold water used in upper part.



FRICK COMPANY,

ENGINEERS, WAYNESBORO, PA.

Direct Expansion Baudelot Cooler for Beer Wort. Cold water used in **upper part.**

MECHANICAL REFRIGERATION IN BREWERIES.

The various applications of the modern method of cooling by use of Mechanical Refrigerating Machinery of the Compression type has in no instance of its widely developed fields of usefulness met with greater success than in breweries; and, as a fact none the less interesting to know, that the ever-increasing popularity of the products of the breweries owes much of its fine quality and success as a favorite beverage to the introduction of Mechanical Refrigeration, which also enables the business to be carried on in the warmer latitudes where a very few years since it was considered impossible to operate a brewery, owing to the climatic conditions and great expense of producing natural ice.

As remarked in our hearing by one of the brightest and largest brewers in this country: "Mechanical refrigeration has enabled all good brewers to insure continual excellence of product and the smallest to compete with the largest." This same gentleman rather bewailed the fact that refrigerating machinery allowed his smaller brethren to compete; but what may be his loss is gain to others, and we can assure all that neither by high prices, or withholding from them the best we have, will we help build up and maintain a corner in refrigerating machines.

THE USES FOR MECHANICAL REFRIGERATION IN A BREWERY.

One of the first operations is the refrigerating of the hot beer wort which has previously been cooled somewhat by having been exposed in the "cool ship" (a large shallow tank generally placed upon the top of a building and housed in by open lattice work, which allows the air to circulate and carry off considerable of the heat from the hot wort). Thence the wort flows down over what is called a "Baudelot" cooler, through the upper portion of which hydrant or well water is used, the lower portion of the cooler being mechanically refrigerated by direct expansion of ammonia, by brine circulation or circulating ice water.

FERMENTING TUB ATTEMPORATORS.

Temperature of fermentation is regulated by attemporators through which ice-cold water or brine is pumped. One form of attemporator is used, shown on page 118. In the brine system the ice-water is cooled in a cistern or suitable tank provided with either a direct ammonia expansion or brine coil, supplied by the refrigerating machine, the sweet or ice-water thus made being forced through the attemporator in the tubs, each or any number of which can be shut off or regulated at will, the pressure and amount of cooling water being under automatic control of our self-acting pump and regulator which supplies the attemporators and needs no attention, whether one tub or many be in use.

FERMENTING ROOM COOLING.

As shown upon page 117, the coils being variously arranged, care being taken in all cases to avoid drip from the pipes into the tubs.

BEER STORAGE ROOMS AND VAULTS.

Shown upon page 116, showing coils arranged on the ceilings.

In vaults, the plans shown upon page 116 we have used with greatest satisfaction, this arrangement taking up but little room and presents a handsome appearance.

RACKING ROOM AND KEG STORAGE.

As shown upon page 116, a proper arrangement of piping being used in these rooms to insure very low temperatures.

NO NATURAL ICE NEED BE USED.

Allow us to state that the use of natural ice for any purpose in the brewery premises is done away with.

ICE FOR SHIPMENT OF BEER.

We can furnish in connection with our refrigerating machinery a complete ice-making plant to supply ice used for packing and shipment of beer.

ATTEMPORATOR SYSTEM.

We are prepared to furnish attemporators or swimmers of various styles, complete with all connections and plans for erecting the same. We furnish the Ring attemporators, for brine, ice-water or direct expansion. For description of our Standard Attemporator system see page 118.

BAUDELOT AND WATER COOLERS.

We furnish a full line of coolers for beer wort adapted for either brine or direct expansion; or for cooling brine or sweet water for use in the attemporators; also, for cooling distilled water in ice factory; made of bright iron or copper-covered pipe, as desired (see page 119).

REFERENCES FOR OUR ECLIPSE REFRIGERATING MACHINERY IN BREWERIES.

Below we publish a partial list of parties who have our improved Refrigerating and Ice-making Machinery in breweries. Please to ask them what they think of it, and learn for yourself if they support our claim that we build the best.

Phoenix Brewing Co., Baltimore, Md.,	27	ton	Refrigerating	capacity.
Gipps Brewing Co., Peoria, Ill.,	50	"	"	"
Sprattler & Mennell, Paterson, N. J.,	32	"	"	"
Herman Lackman, Cincinnati, O.,	65	"	"	"
Henry Fink, Harrisburg, Pa.,	32	"	"	"
Sebastian Helldorfer, Baltimore, Md.,	32	"	"	"
Frank Reisch & Bro., Springfield, Ill.,	50	"	"	"
Jos. Stein & Co., Louisville, Ky.,	23	"	"	"
Meyer & Reidlin, Covington, Ky.,	32	"	"	"
Bellevue Brewing Co., Cincinnati, Ohio,	50	"	"	"
Cumberland Brewing Co., Cumberland, Md.,	27	"	"	"
Parkersburg Brew. Co., Parkersburg, W.Va.,	27	"	"	"

Others in process of erection.

TESTIMONIALS

FROM

USERS OF OUR ECLIPSE ICE-MAKING AND REFRIGERATING MACHINERY IN BREWERIES.

OFFICE OF HENRY WERNER,
PHOENIX BREWERY, No. 370 Pennsylvania Avenue,

BALTIMORE, MD., *June* 17, 1886.

Messrs. FRICK COMPANY, Manufacturers of Refrigerating Machinery,
Waynesboro, Pa.

Gentlemen :—The twenty-ton refrigerating machine and complete system of piping for cooling my brewery, including the cooling also of beer wort on the Baudelot and in the attemporators or swimmers in the fermenting tubs, that you erected for me in the spring, I am happy to say has exceeded the contract agreement, and does away with the use of natural ice for any purpose whatever about my establishment. I am pleased to say I do not have to run my machine night and day as other brewers in this city find it necessary to do in order to secure in their cellars the desired low temperature of 36 degrees Fahr., but I run only ten to twelve hours per day. I believe I possess the best refrigerating machine in the City of Baltimore, and it is a great pleasure to me to recommend to brewers, and especially to those who are cautious and wish to avoid experimental machinery, Frick Company's make of Ice and Refrigerating Machinery.

Wishing you continued success, I am, yours truly,

HENRY WERNER.

S. HELLDORFER,
STAR LAGER BEER BREWERY.

BALTIMORE, MD., *December* 17, 1888.

FRICK COMPANY, Waynesboro, Pa.

Gentlemen :—It gives me great pleasure to have an opportunity of testifying to the general efficiency and merits of the 25-ton "Eclipse" Refrigerating Machine erected on my premises in the spring of '86.

The machine has now been in operation two seasons, and during this period has not only performed its work admirably, but has given me better results than stipulated in contract.

Cellars aggregating over 85,000 cubic feet were cooled, the temperature being kept at any desired point with ease. Racking room, 32 degrees. Chip cellars, 34 degrees. Storage cellars, 34 degrees. Fermenting room, 38 degrees.

The average working time was 18 hours per diem ; consumption of coal about 3000 pounds. Estimated quantity of water used for condensing purposes, 20 gallons per minute. As I have no well water on the premises, the entire supply is obtained from the city mains. The temperature of water procured from such a source, during July and August, is as high as 85 and 88 degrees. Seventy barrels of beer are brewed and cooled daily on the Baudelot Cooler from April until November.

I invite a personal inspection of my plant by any parties contemplating the erection of refrigerating machinery, and will cheerfully give any information that may be desired. This machine is a model of excellent workmanship, possessing unusual strength and rigidity of frame, combined with handsome design and pleasing appearance, entitles it to its claim of being first-class in every respect. Number of revolutions per minute, 40 ; while cooling beer, 55.

Very respectfully,
SEBASTIAN HELLDORFER.

65-TON MACHINE IN A BREWERY.

CINCINNATI, O., *Sept.* 25, 1888.

Messrs. FRICK Co., Engineers, Waynesboro, Franklin Co., Pa.

Gentlemen :—Yours in request of an expression of my views as to the performance of the refrigerating apparatus you put in for me in the spring to hand. I am happy to state that the entire plant has given me utmost satisfaction. From the following statement you can easily see why I am so well pleased: During the months of July and August I brewed two brewings one day and three brewings the next, or an average of 225 barrels of beer wort per day. Your machine took care of this wort, cooling it to the desired temperature on the Baudelot cooler before it went into the fermenting rooms. Besides this, my cellars, about 250,000 cubic feet space, never were above 33 degrees Fahr., but oftentimes below 32 degrees Fahr., my fermenting rooms always being at a regular temperature. The attemporators and sweet water system furnished has been all that could be desired, working steadily and doing all the work required. The test part of the whole is, during this time, the hottest months of the summer, your machine does this entire work, *running but* 14 *hours per day, and only required one engineer and one fireman* to attend to it, they taking charge of the whole apparatus. To show how much work was required of the machine, I will add that after cooling the beer wort we would run until the brine was down to 10 degrees Fahr., then shut everything down except the brine and attemporator pumps and leave it until the following morning. Now, the three brine tanks, which are 10 feet diameter by 12 feet high, hold about 20,000 gallons brine. This brine would raise from 10 degrees to 30 degrees during 10 hours the machine was stopped. When it is taken into consideration that this time was during the night, when the cellars were closed and no men working in them with lights or warm water, and the atmosphere at its coolest temperature, some idea of the amount of work required by the machine during its working hours can be had. The coal used during this time never exceeded three tons per day. This made steam for the whole plant, consisting of Corliss engine running the machine, the brine, the Baudelot, the attemporators and the boiler feed pump; also two deep well pumps to which the steam was carried about 100 feet or more. This coal was also used to bank the fires at night, and to furnish the necessary steam to run the brine and attemporator pumps, which run continually. So much for the working of the plant. As to the general construction and class of the work you put into it, I can say that in my judgment, as in the judgment of several mechanical experts who have given me their opinions, everything is of a superior character and first-class in every respect. The machine is massive and ample, doing the work guaranteed for 24 hours in 14 hours, running at a moderate speed which insures long life and few repairs. All the pumps are of the duplex pattern, and are well supplied with stop valves, making everything convenient and interchangeable. The boiler is of steel and larger than contracted for. In the cellars the same principle seems to have been carried out. Everything is strong—and there is no scarcity of anything—plenty of piping and good supports, with valves wherever a valve would be any use. The finish everywhere is pleasing to the eye and substantial, and everything modern and workmanlike. In conclusion, I will say your machinery has more than fulfilled the contract between us. My premises are open to the inspection of any one who cares to investigate the above statement, and it always affords me pleasure to show up my choice of all the refrigerating machines now in the market.

Wishing you a continual success, I remain

Very respectfully yours, (Signed) HERMAN LACKMAN.

PEORIA, ILL., *December* 1, 1888.

FRICK COMPANY, Waynesboro, Pa.

Gentlemen :—Having experienced great losses and unsatisfactory results in the use of other makes of refrigeratory machinery, we finally closed a contract with your Mr. Edgar Penney for a 40-ton Eclipse some two years ago.

That machine has been running two summers and we have gradually come to relying on it entirely. We use no ice around our premises or cellars. Cool one hundred and fifty barrels of hot wort daily.

Keep our cellars from 34 to 42 degrees Fahr. as may be desired. The attemporators control the fermentations at any stage ; and in every way the machinery more than fulfills Mr. Penney's guarantees. It requires so little attention that one engineer attends to all our other machinery as well as the Eclipse Refrigerator plant, and we require no night engineer, as we seldom run over twelve hours at a time.

We have added but one drum of ammonia to replace loss this season.

Our small consumption of fuel, oil, packing and condensing water is a constant surprise to us. We believe you are making the best machine in the market. Respectfully yours, etc.,

GIPP'S BREWING COMPANY,
by W. H. BALLANCE, *Treasurer.*

The above machine replaced an "Arctic" double-acting.

KEYSTONE BREWERY,
812, 814, 816 and 320 Forster Street,
HENRY FINK, *Proprietor.*

HARRISBURG, PA., *December* 14, 1888.

FRICK COMPANY, Waynesboro, Pa.

Gentlemen :—I have had the 25-ton "Eclipse Refrigerating Machine," which you erected for me last winter, in operation during the season, and am pleased to state the machine has done all you claimed and more.

In fact, I am so perfectly satisfied with its working and construction that, should I be in need of another, I would, without hesitation, order one of the same make.

I shall be pleased to show the plant to any party wishing to purchase a refrigerating machine.

Wishing you continued success, I remain,

Yours, etc., H. FINK.

W. Riedlin, *President.* Anton Ruh, *Superintendent.*
John Meyer, *Vice-President.* J. H. Kruse, *Secy. and Treas.*
The Bavarian Brewing Company,
Telephone 4196. 367 and 369 Pike Street.

Covington, Ky., *October* 15, 1889.

Frick Company, Waynesboro, Pa.

Gentlemen :—In answer to your request, we cheerfully certify that the 35 ton ice-machine and Corliss engine, which you erected for us last spring, in operation during the season, and am pleased to state the machine has done all you claimed and more. In fact, we are so perfectly satisfied with its working and construction that, should we be in need of another, we would, without hesitation, order one of the same make.

We will be pleased at all times to show our plant to visitors. Any information we can give will be cheerfully given.

Respectfully yours,
THE BAVARIAN BREWING COMPANY,
by Wm. Riedlin, *President.*

Office of JOS. STEIN & CO., *Proprietors*
Southern Lager Beer Brewery,
Green Street, between Wensel and Baxter Avenue.

Louisville, Ky., *October* 17, 1889.

Frick Company, Waynesboro, Pa.

Gentlemen :—After a five months' trial of your "Eclipse" Refrigerating Machine, we are pleased to say that the same has given entire satisfaction, and will take pleasure in recommending the same to parties in need of refrigerating machines. Very respectfully,

JOS. STEIN & CO.

Frank Reisch. George Reisch. Joseph Reisch.
Established '49.
Office of FRANK REISCH & BROTHERS, *Proprietors*
City Brewery.

Springfield, Ill., *November* 4, 1889.

The Frick Company.

Sirs :—Replying to your favor of the 12th ultimo, we are pleased to say that the 50-ton Eclipse Refrigerating Machine does all we expected and gives satisfaction.

We cheerfully recommend it to the trade.

Yours, etc., F. REISCH & BROS.

CHAPTER VIII.

THE ECLIPSE MACHINE IN PACKING HOUSES —ILLUSTRATED.

HOG HANGING ROOMS.

BEEF ROOMS.

LIST OF REFERENCES TO PACKING HOUSES.

WHAT THE BIG PACKERS SAY OF OUR BIG MACHINES.

COLD STORAGE—ILLUSTRATED.

MEAT AND PRODUCE ROOMS.

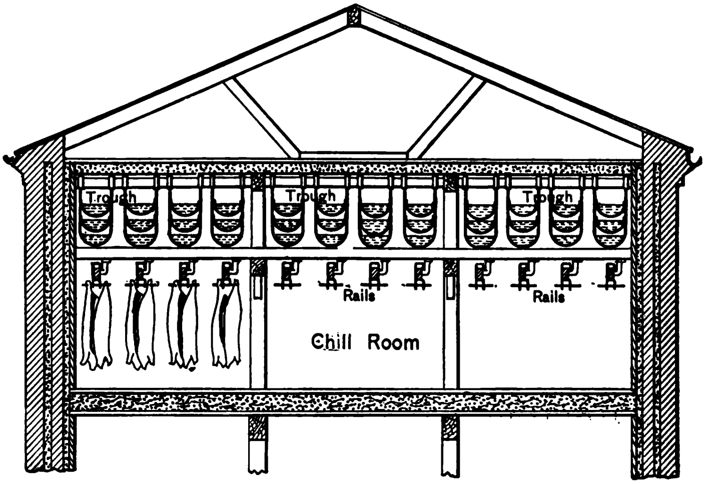
TESTIMONIALS FROM COLD STORAGE HOUSES.

TABLE OF PRICES PAID FOR VARIOUS KINDS OF COLD STORAGE.

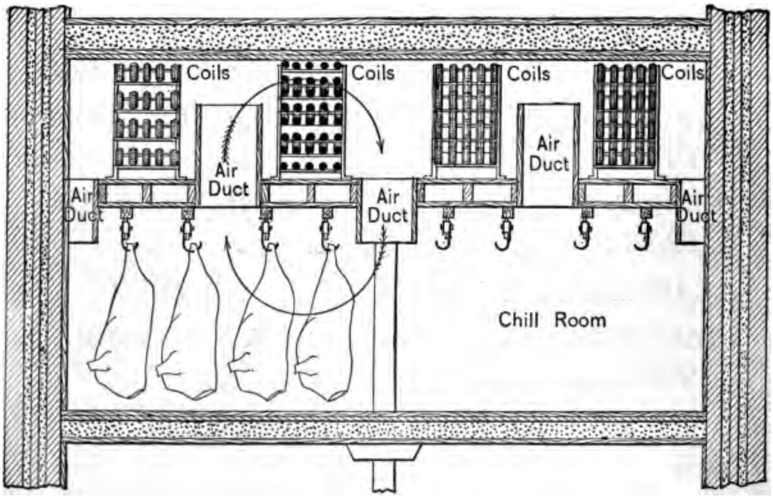
INSULATIONS OF BUILDINGS AND PLANS FOR SAME.

READ THIS CHAPTER.

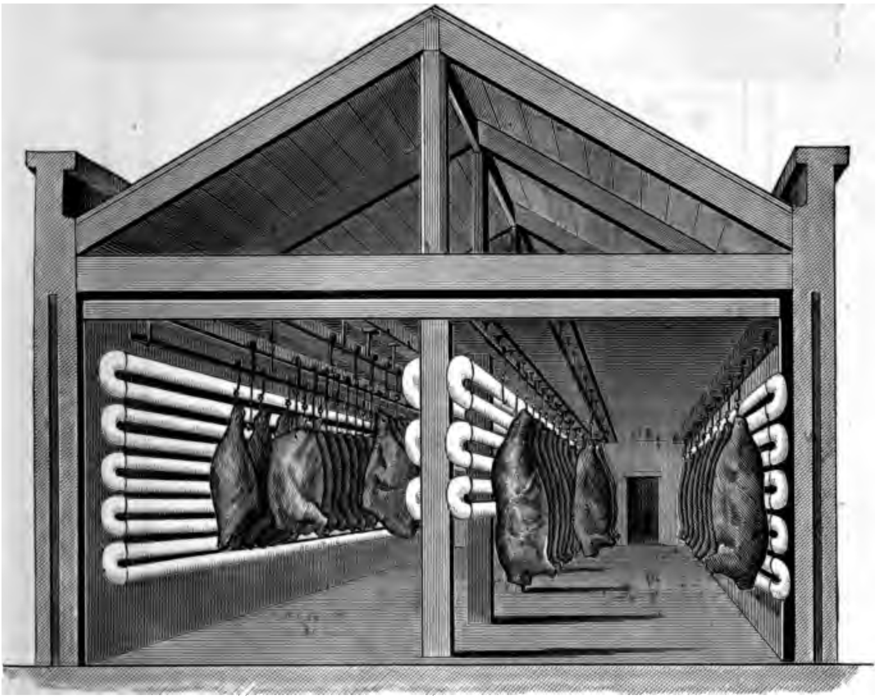
COMPLETE SPECIFICATION OF A REFRIGERATING PLANT.



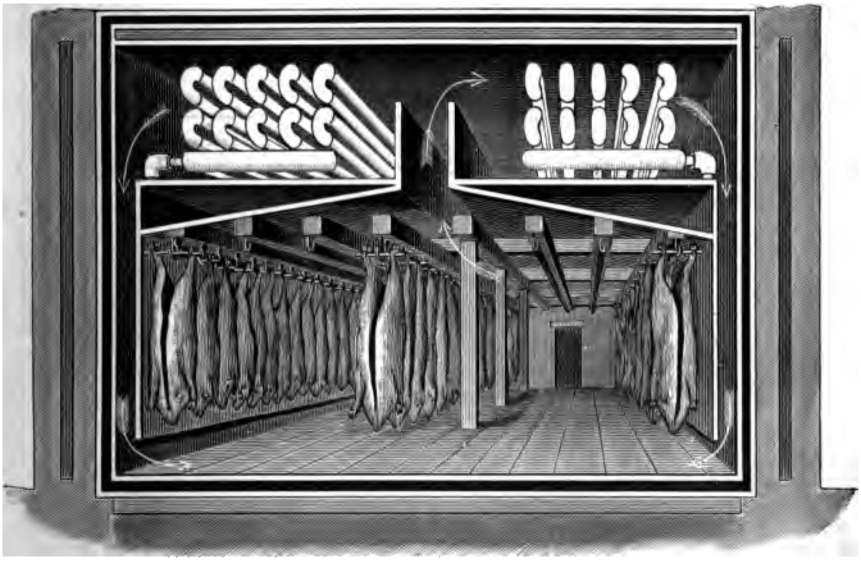
Hogs hanging in Chill Room
Open Trough System over each Hog Rail
FRICK COMPANY
ENGINEERS WAYNESBORO
FRANKLIN CO., PA.



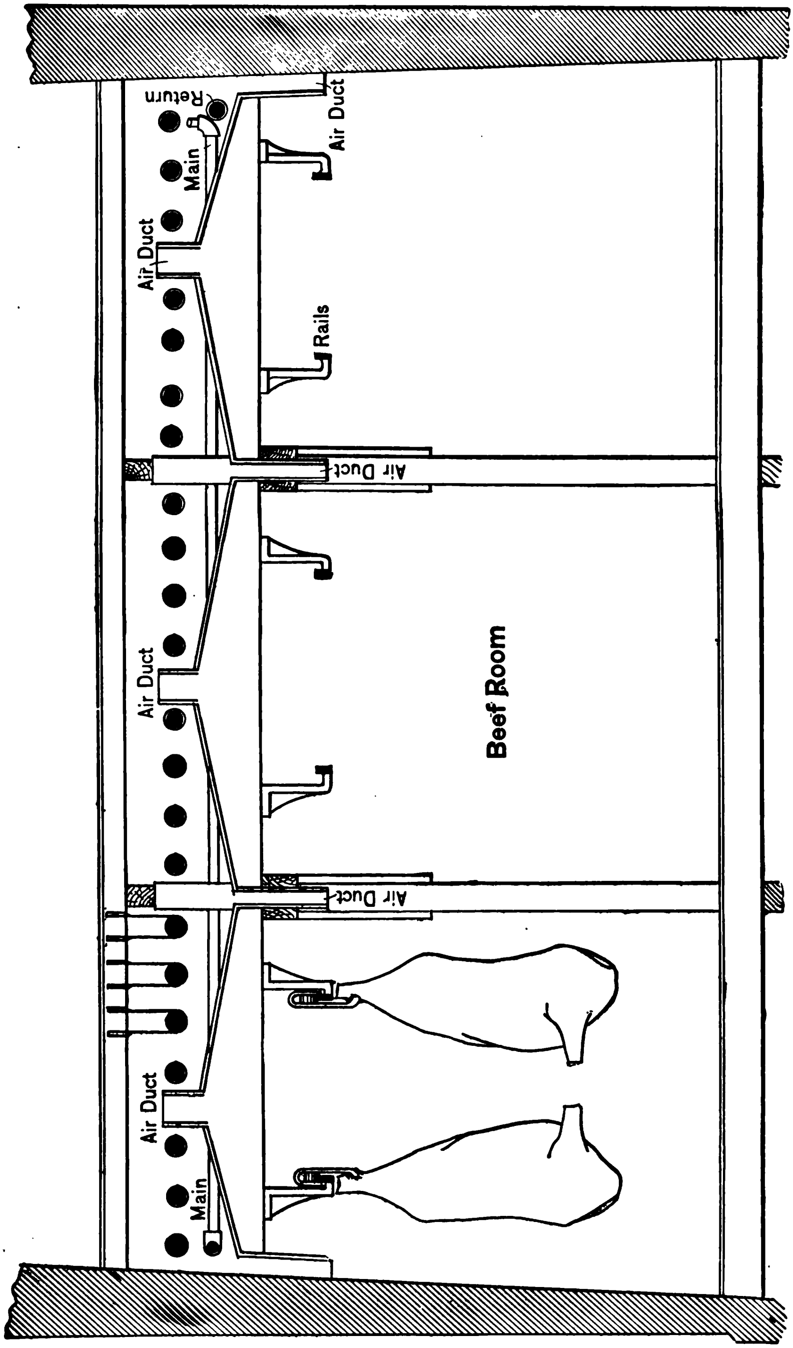
Beef Hanging in Chill Room
Box Coils in Chamber overhead.
FRICK COMPANY
ENGINEERS WAYNESBORO
FRANKLIN CO., PA.



Beef Chill Room, with Coils on Sides of Room.



Hog Chill Room—Coils in Overhead Chamber.



BEEF HANGING ROOM
Showing Arrangement of Cooling Ducts and Galvanized Brine Coils in Chamber.

REFRIGERATING PACKING HOUSES AND ABATTOIRS.

The introduction of Mechanical Refrigeration in the above industries marks a new era in this business, and has as a matter of fact brought about a revolution in the arrangement of buildings and in the methods of caring for fresh killed hogs and beef and storage in packing houses.

As some of the older packing houses have not yet adopted Mechanical Refrigeration, owing, perhaps, to difficulties in adapting a good system to their old buildings, we have studied to meet just such cases by presenting a variety of methods which can be introduced with little or no change in the premises, and we show this by means of various engravings in the preceding pages.

By our plan of Mechanical Refrigeration the temperature of a hanging or chill room can be regulated and maintained to exactly suit the requirements without regard to external conditions of the atmosphere and amount of internal cooling work to be done. There is no danger of such rapid freezing as to simply chill the outside surface of the carcasses and endanger the proper curing, because the animal heat can be taken up thoroughly by simply regulating the temperature, thus insuring the carcasses being uniformly chilled throughout.

Our Refrigerating Machinery is in successful operation in some of the largest packing houses in the United States, and our experience has been such that we guarantee with confidence a perfect adaptation and installation of Refrigerating plants at the minimum cost, enabling by means of our system the business to be carried on in midsummer with the same certainty and satisfaction as in midwinter.

HOG COOLING ROOM,

shown in engraving on page 128, shows an adaptation of open cooling troughs over each hog rail, and is intended for brine circulation, the amount of brine flowing over the several surfaces being regulated by simple means. This plan presents advantages which will appear to those interested.

ANOTHER PLAN FOR HOG ROOMS,

shown upon page 129, is the use of coils in a cooling chamber overhead, with a proper construction and arrangement of air-ducts introduced to insure ventilation and rapid circulation of the cold air.

STILL ANOTHER PLAN FOR CHILL ROOMS,

as shown on page 129, is to place cooling pipes on the sides of the room, the hogs or beef being suspended between the coils.

BEEF ROOM.

The plan shown upon page 130, with its system of large galvanized pipe and the simple arrangement of air-ducts for cold air circulation, is effective. As proved by extended use, it practically fills all the requirements, all drip and moisture being prevented.

BEEF ROOM WITH BOX COILS

is another favorite plan where room cannot be obtained for overhead cooling chamber, page 128.

DIRECT EXPANSION.

All the above plans, except the open trough system, can be used with either direct expansion of ammonia or brine system.

GENERAL STORAGE ROOM.

The plan shown in page 140 is for general storage rooms, the coils being placed overhead or on the sides.

PRODUCE ROOMS,

shown on page 140. The plan of piping here shown is similar to the general storage rooms.

PLANS TO SUIT LOCATION.

We furnish plans to suit the location and premises, guaranteeing the character of the work, and consider carefully the best arrangement with the least possible expense in changing the premises to suit.

REFERENCES FOR OUR ECLIPSE REFRIGERATING MACHINERY IN COLD STORAGE HOUSES.

J. C. Shafer & Co., Baltimore, Md.,	40	ton	Refrig.	cap.
C. Cassard & Sons, Baltimore, Md.,	25	"	"	"
Baltimore City Storage Company, Baltimore, Md.,	32	"	"	"
Armour Packing Company, Kansas City, Mo.,	100	"	"	"
Shallcross & Son, Coatesville, Pa.,	15	"	"	"
Washington Market Company, Washington, D. C.,	32	"	"	"
Armour Packing Co., Kansas City, Mo., 2d order,	125	"	"	"
Francis Whittaker & Sons, Wichita, Kan.,	125	"	"	"
Emil Winters, Pittsburg, Pa.,	37	"	"	"
Frank Seifried, Louisville, Ky.,	7	"	"	"
Chicago Pack. and Prov. Co., Chicago, Ill., 2d order,	150	"	"	"
Steelton Store Company, Steelton, Pa.,	10	"	"	"
Pittsburg Meat Supply Company, Allegheny, Pa.,	50	"	"	"
J. Vogle & Sons, Cincinnati, Ohio,	50	"	"	"
John Hately, Chicago, Ill.,	65	"	"	"
Geo. Hammond & Co., Chicago, Ill., 2d order,	150	"	"	"
Calumet Canning Company, Hammond, Ind.,	32	"	"	"
Westchester Cold Storage Co., West Chester, Pa.,	10	"	"	"
Alberto Malo, Mexico, Mexico,	60	"	"	"

Other plants in process of erection.

TESTIMONIALS

FROM

USERS OF OUR ECLIPSE ICE-MAKING AND REFRIGERATING MACHINERY IN PACKING HOUSES.

ARMOUR PACKING COMPANY.

ARMOUR & CO., Chicago, Ill.
ARMOUR BROS. BANKING CO., Kansas City, Mo.
H. O. ARMOUR & CO., New York.

KANSAS CITY, MO., *Aug.* 26, 1887.

FRICK COMPANY, Waynesboro, Pa.

Gents:—The one-hundred ton Eclipse Ice Machine you put in for us is doing all you guaranteed it to do, and much more. We are well pleased with it in every respect, and don't think there is any machine that is superior to it.

Yours truly,

ARMOUR PACKING CO.
G. W. TOURTELLOT, *Supt.*

WHAT THEY SAY OF OUR MACHINE AFTER 18 MONTHS' USE.

ARMOUR PACKING COMPANY.

Armour & Co.,
Chicago, Ill.

Armour Bros. Banking Co.,
Kansas City, Mo.

H. O. Armour & Co.,
New York.

Kansas City, Mo., *Nov.* 29, 1888.

Messrs. Frick Company, Waynesboro, Pa.

Gents:—In answer to your request, we cheerfully certify that the 100 ton Ice Machine and Corliss Engine purchased from you about eighteen months ago has given entire satisfaction in every respect, and not only comes up to your guarantee, but does more work than you claimed for it.

It gives us little or no trouble, and the expense for repairs is not worth mentioning.

We are more than pleased with it, and feel perfectly safe in saying that for durability, economy and work done, it is surpassed by no other machine in the market, and we take pleasure in recommending it to those who contemplate purchasing refrigerating machinery.

Yours very truly,
ARMOUR PACKING CO.

December 24, 1888.

Proof of the sincerity of the above is just corroborated by a second order from Armour Packing Co. for one of our 125-ton machines, which takes the place of three fifty-ton "Arctics" (double-acting).

Office of CASSARD & SONS,
Packing and Cold Storage House, W. Baltimore Street.

Baltimore, Md., *June* 17, 1886.

Messrs. Frick Company, Waynesboro, Pa.

Gentlemen:—We have had in use one of the Eclipse Patent Refrigerating Machines manufactured by your Company some three years since. The machine is of the old design, and while it does not compare in many respects with the later and improved machine, of which you have just placed in successful operation several in this city, we can confidently say that we have never found or heard of a better one than this, until you brought out the new one. This machine is cooling 300,000 cubic feet of space in our Packing and Cold Storage Houses, and we doubt if any other machine in the market would have so completely filled the bill and responded so successfully to the demands of our business. We are pleased and more than pleased with the machine, and want to do a good service to all packers by telling them to be sure and buy your new Eclipse Refrigerating Machine in preference to all others. We will be pleased to show interested parties the plant at any time.

C. CASSARD & SON.

☞This machine has vertical pumps and vertical engine, one of the first made by us seven years since.

J. Shallcross & Son,
Wholesale and Retail Provision Dealers,
No. 16 Second Avenue.

Coatesville, Pa., *Dec.* 14, 1888.

Messrs. Frick Company, Waynesboro, Pa.

Gentlemen :—Since writing our letter of August 20, 1887, we have had no cause to change a word contained therein, but must say that we are fully satisfied with the work performed by the machine during the past season. Last winter we fitted up a small room for the storage of butter, in addition to the other rooms we have cooled. This has been a perfect success and a source of considerable revenue. Hear what one of our patrons has to say about it: "I am very much pleased with your storage; the butter is the best I ever saw, and all who have used it say so. I will send all there next summer."

We also added last spring a special tank for the manufacture of ice, with capacity of 5 tons per 24 hours.

Since June 25 we have had two engineers. Have been running the machine on an average during the hot weather of about 22 hours per day, with a speed of not over 60 revolutions per minute.

Have kept our rooms to the required temperature, and during the month of August averaged 5 tons of ice sold per day. Being a new enterprise, we were not able to find sale for the full amount of our capacity.

The actual waste of ammonia during the season of 1888 has not, in our judgment, exceeded one flask of 125 pounds.

The average consumption of coal has been 2600 to 2800 pounds of George's Creek bituminous coal per day.

The machine has been working very smoothly all season; the bearings being so heavy that the season's wear is hardly noticeable. Have not had any trouble at all with piston rods or bearings heating.

We have had quite a large number of visitors to see our plant, all of whom express themselves highly pleased with the workmanship, and especially have they admired the substantial build of the machine.

We will be pleased at all times to show our plant to visitors. Any information we can give will be cheerfully given.

Yours respectfully, J. SHALLCROSS & SON.

Note.—The above machine replaced a Linde double-acting.

Baltimore, Md., *November* 30, 1888.

Frick Company, Waynesboro, Pa.

Dear Sirs :—We have had one of your 35-ton "Eclipse" Refrigerating Machines on our premises for two years, and are happy to state that it has given us perfect satisfaction and has accomplished all you claimed for it.

Before selecting your machine, we had carefully examined the merits of the different makes in the market, and we concluded that yours was the most economical, in fact, as well as the most desirable, effective and cheapest machine offered.

In this opinion we had the concurrence of the engineer in chief of the United States Navy, who at the time had just concluded an examination of the refrigerating machines then upon the market.

Respectfully yours, JACOB C. SCHAFER & CO.

ARMOUR PACKING COMPANY.

Kansas City, Mo., *October* 4, 1889.

Frick Company, Waynesboro, Pa.

Gentlemen :—In answer to your favor of the 27th ultimo, asking us to submit a testimonial to you with reference to the working and satisfaction given us of the 150-ton refrigerating machine and 75-ton ice plant furnished us last spring, we beg to state that in all particulars have they both given us entire satisfaction. The refrigerating machine has been in operation since July 1, and the ice plant since May 12, and up to this time we have yet to offer the first complaint, as they have both come up to guarantees made in contract. Trusting this will prove satisfactory, we remain,

Yours respectfully,
ARMOUR PACKING CO.
G. W. Tourtellot.

FRANCIS WHITTAKER & CO.

Wichita, Kans., *October* 5, 1889.

Frick Company, Waynesboro, Pa.

Dear Sirs :—After careful investigation of the compression system and compression machines (we having used absorption machines for seven years), we decided to purchase your one hundred and twenty-five ton "Eclipse" Machine. We are pleased to say it is very satisfactory in every particular. The machine is perfectly adapted for the purpose (compressing ammonia) for which it is used. The duty performed is over 150 tons refrigeration, and exceeds your guarantee 20 per cent. Every part fits to a nicety and can be put together without trouble or difficulty. We don't think there is any machine that is superior to it.

FRANCIS WHITTAKER & SONS.
R. A. Hamilton, *Supt.*

REFRIGERATING PLANT SPECIFICATION.

WHAT WE FURNISH WITH OUR STANDARD PLANT.

MACHINE SYSTEM.

One or more pairs of single-acting Gas Compressors as may be required, complete with Corliss or Cut-Off Steam Engines to drive same, necessary Ammonia condenser, Oil separators, Traps, and all ammonia pipe connections complete. Called the *Compression Side.*

BRINE TANK SYSTEM.

Suitable Brine Tanks of adequate dimensions, made of iron and well braced, containing suitable Ammonia Evaporating Coils, Stands and Headers ; said coils tested to 300 pounds air pressure under water. Proper suction connection nozzle for attaching brine pump. All iron work painted with brine proof paint. Tanks wood-lagged and fitted with removable covers, and insulated with granulated cork.

Worthington pattern, Duplex brass-lined, self-acting Steam Brine Pumps of ample capacity, connected to Brine Tank by suitable pipe connections, and shut-off valve with special strainer in suction-pipe.

CHEMICALS.

Sufficient tons of salt to fully charge the brine tanks at ninety per cent density, as per salt gauge ; and full charge of anhydrous ammonia, if so agreed.

PIPE WORK IN APARTMENTS.

Piping of rooms and all apartments to be cooled, when required, either for the circulation of brine or direct expansion, in a first-class workmanlike manner.

We are prepared to furnish additional tanks, special apparatus, steam or power pumps, or other machinery required.

STEAM BOILERS.

When furnished by us, to be Horizontal Tubular, fitted with full flush front, fixtures and mountings which comprise everything necessary for setting boiler (except mason work and material), smoke-stack with damper, guy rods and hood.

Boilers furnished with our plants are guaranteed to be of ample capacity to furnish steam to operate Refrigerating Machine and all pumps required.

Steam feed pump and connections furnished with steam boiler plant. Also feed water heater of suitable capacity, guaranteed to heat the feed water from 60 to 210 degrees Fah.

ERECTION OF MACHINERY.

We furnish one competent erecting engineer to superintend the erection; purchaser to furnish one engineer to assist in erecting and receive instruction in putting together and running the machinery.

Complete plans furnished for foundations (and when required, of building to accommodate machinery).

Foundation bolts for machine, with anchor washers and templates for setting.

We will furnish, if so agreed, all necessary labor for hoisting, moving and placing machinery in proper position.

Purchaser is required to supply all temporary blocking, staging and timber that may be needed in execution and erection of work, and to remove same when job is finished.

If so agreed, we will furnish a competent rigger, or in lieu thereof, for erecting purposes only, suitable rigging tools, consisting of such tackles, levers, rollers, hoisting windlasses, chain hoists, ropes, slings, jackscrew and appliances usually called into play in the erection of heavy machinery.

Purchaser will be required to furnish the following: To pay freight or transportation expenses, and supply water under pressure, or fresh water pump and necessary water pipes to condenser tank, with sewers and drains, at convenient points nearest to machinery, and erect, at their own expense, all foundation work, masonry, carpenter work, and furnish suitable materials and labor therefor, and properly prepare approved buildings, or make necessary changes in present buildings, to receive machinery according to our plans.

Steam and Exhaust Pipes, fittings and sundry pipe connections to connect boiler, engine and brine and other pumps, together with all overflows, drip pipes to the sewers, condensing and jacket water supply, needed to complete and make ready for full and continuous operation, all machinery to be furnished and erected, by purchasers or ourselves as per agreement.

GUARANTEES.

We guarantee that machinery furnished by us shall, when in full operation, cool all rooms and apartments, cellars and spaces, to temperature as low as may be needed for the safe conduct of the purchaser's business.

We guarantee, if for a Brewery, to cool required barrels of beer wort on the Baudelot cooler, and furnish all apparatus for same, from a temperature of 90 degrees Fah. to 40 degrees Fah. if required; the use of spring, well or fresh water is, however, recommended on the upper half of Baudelot, thus cooling the beer to 70 degrees Fah. before it is delivered upon machine-cooled portion.

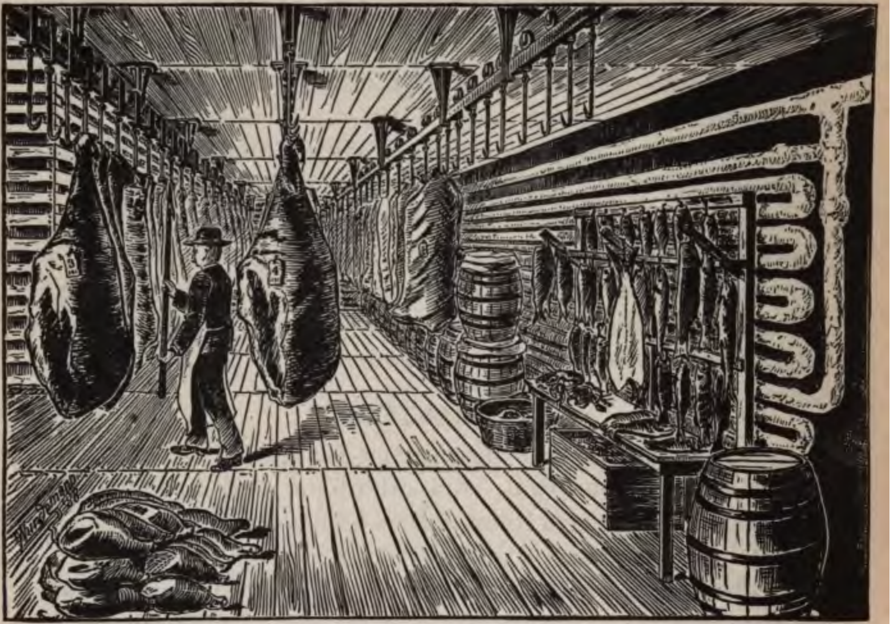
We guarantee to make needed gallons of ice or sweet water to a temperature of 32 to 34 degrees Fah. for use in the swimmers, and furnish complete attemporator system if required.

IF FOR A PACKING HOUSE.

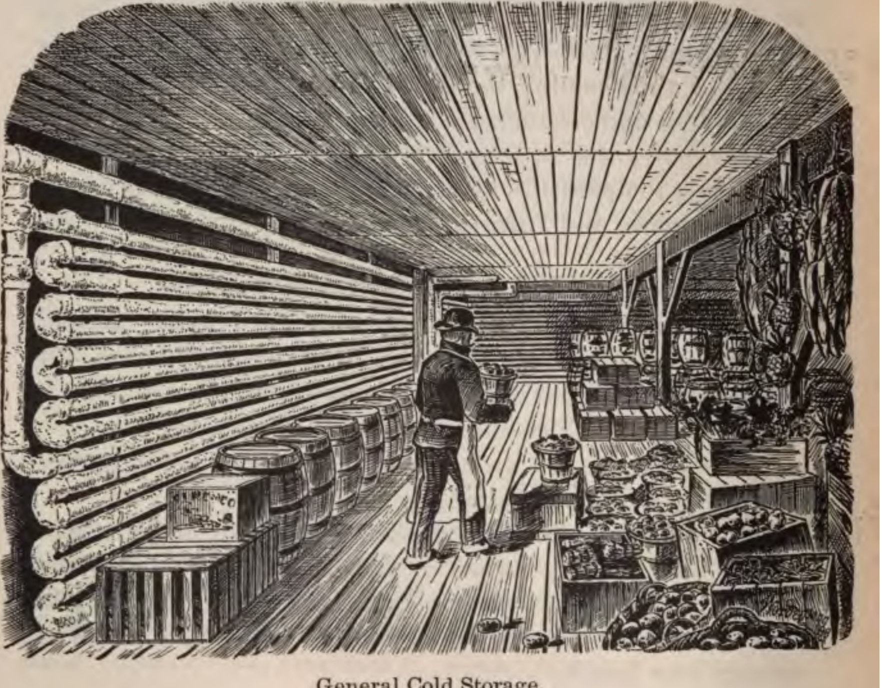
We guarantee to cool and properly chill stated number of hogs, of about 250 pounds each, in twenty-four hours. Or in lieu thereof, given number of beeves of about 600 pounds each, or sheep, calves, etc., in twenty-four hours.

Provided, in all cases, that the rooms are properly insulated and piped in a proper manner.

We guarantee our Refrigerating machine, under actual test, to give a duty equal to the melting of tons of ice named in twenty-four hours, with an expenditure not to exceed a stated number of pounds of good steam coal in twenty-four hours.



Mixed Cold Storage.



General Cold Storage.

We guarantee the Refrigerating machine condenser and jackets to use not to exceed one gallon of condensing water per minute for each ton capacity, condensing water based at a maximum temperature of 60 degrees Fah.

We guarantee workmanship and materials for one year, provided no disarrangement is caused by carelessness, incompetency, or want of attention of person in charge, and if run according to our instructions.

We guarantee our machinery not to interfere with or infringe upon other patents, and will bear all expense of patent litigation relating to same, should any be attempted, leaving purchaser free and harmless.

Payments, one-quarter cash with order, one-quarter cash on arrival of machinery on cars at nearest point, one-quarter cash after thirty days' test, and the balance by interest-bearing note, payable two months after termination of test, *or as may be otherwise agreed.*

REFRIGERATING AND COLD STORAGE.

We have supplied many plants for the general business of preserving perishable products. Some of these enterprises were devoted exclusively to cold storage warehouse purposes, and others were "combination plants" for making ice and cold storage on the same premises. We especially recommend this latter plan as being well adapted and remunerative in all smaller towns and cities when the home demand will not support a special cold warehouse.

COLD STORAGE PRICE LIST AND BEST TEMPERATURES.

We are so often asked by our customers to name the rates and give such information relating to the business, that we trust prospective buyers will find their questions anticipated and fully answered below. The rates vary slightly with the locality, and may be governed somewhat by the ruling prices of ice. We give highest and lowest obtained by our customers who store all classes of goods and are located in different parts of the country.

MECHANICAL REFRIGERATION.—RATES FROM PRINCIPAL COLD STORAGE HOUSES.

TABLE OF GENERAL STORAGE.

SUBSTANCE.	CONDITIONS. Kind of Package or Amount.	Best Temperatures.	Fraction of a Month.	First Month.	Each Succeeding Month.	For the Season.	Season Ends.	General Season is from May to May.
Butter	Transient small lots	32° to 38°	⅓c.	¼c.	⅕c.		......	Gross weight.
	500 to 1000 pounds	“	....	....	....	⅛c.	......	“ “
	10,000 pounds	“	....	....	....	¼c.	......	“ “
	Season rates before the 15th of August.	“	....	....	....	1c.	May 1	“ “
	After 15th of August to 1st of October.	“	....	....	....	¾c.	“	“ “
	After 1st of October	“	....	....	....	⅓c.	“	“ “
	Carried over one season	“	....	....	....	3¾c.	......	Net weight.
	Carried over two seasons	“	....	....	....	4¾c.	......	
Cheese	60 pound boxes	33°	....	12c.	....	....	......	Per box.
	35 “ “	“	....	8c.	....	....	......	“ “
	18 “ “	“	....	5c.	....	....	......	“ “
	Per pound	“	....	....	¼c.	⅝c.	Dec. 1	Gross weight.
Eggs	30 dozen cases	32° to 34°	....	....	15c.	....	......	Per case.
	36 “ “	“	....	....	18c.	....	......	“ “
	Per dozen	“	....	½c.	½c.	2½c.	April 1	Same rate for part of season.
	In barrels	“	....	....	40c.	....	......	
Dried fruit	Per flour barrel	36°	....	....	....	$1.25	Nov. 1	
Apples, Peaches	sugar barrel	“	....	....	....	1.60	......	
Pears, Cherries	Sacks per pound	“	....	....	....	⅝c.	......	Gross weight.
Berries, &c.	Per pound	“	....	¼c.	....	¾c.	......	
Fresh fruit	In boxes	36°	....	5c.	....	....	......	Per cubic foot.
Apples	In lots of 50 barrels and upwards	28° to 32°	....	20c.	....	$1.00	July 1	
	500 barrels	“	....	20c.	15c.	....	......	
	1000 or over	“	....	....	15c.	....	......	
Peaches	Per crate	....	....	40c.	....	....	......	
Pears	“ barrel	....	....	35c.	....	....	......	
Melons	“ “	....	....	35c.	....	....	......	
Cantaloupes	“ “	....	....	35c.	....	....	......	
Grapes	“ pound	36°	....	½c.	....	....	......	
Lemons, Oranges	Per box	55°	....	25c.	....	40c.	......	
	“ case	“	....	....	....	60c.	......	
Dates and Figs, &c.	Per pound	“	....	¼c.	....	....	......	
Berries	“ crate, large	36°	....	35c.	....	....	......	
“	“ “ small		....	25c.	....	....	......	

Buckwheat	" barrel	32°	....	....	....	1.25	"	
Flour	" pound in sacks	....	....	....	....	⅛c.	......	
Nuts	" pound	....	....	¼c.	....	....	......	
Garden truck vegetables.	" "	36° to 38°	....	25c.	....	....	......	
Dried Corn	" flour barrel	32° to 36°	....	....	....	$1.25	"	
Salt Meat	Per tierce	....	....	25to35	....	....	......	
	" barrel	....	....	20 " 25	....	....	......	
Dried Beef		....	....	35c.	....	....	......	
Lard, &c.	Per pound	....	....	¼c.	....	....	......	
Preserves	" gallon in jugs	33°	....	....	....	5c.	......	
Syrups	" " "	....	....	....	....	5c.	......	
Apple, Peach and Pear Butter.	Half barrel	....	....	....	....	$1.00	Dec. 1	
	Per "	....	....	....	....	2.00	......	
Cider	" " 33 gal	30°	....	....	....	1.00	......	
	" " 42 "	....	....	....	....	1.25	......	
Beer	Half barrel	33° to 41°	....	30c.	....	....	......	
	Quarter "	"	....	15c.	....	....	......	
	Per "	"	....	50c.	....	....	......	
Fresh Meat	" pound	38°	....	¼c.	....	....	......	
	" quarter	....	....	25c.	per	month.	......	
Storage room	Per 1000 cubic feet	....	....	....	....	....	......	$25 and upwards per month.
Veal	" pound	36°	....	25c.	"	"	......	
Lamb	" "	....	....	15c.	"	"	......	

Foreign and domestic fruits, nuts, ¼c. per month or ¾c. per season; in large lots ⅛c. per season.
Other goods than given in table range in quality ⅛c. per pound gross weight per season ending Nov. 1st.

Game		32° to 36°	....	....	....	....	......	15c. per season.
Ducks, Grouse, Quail.	Per dozen	"	....	....	....	....	......	

Storage in Freezing Room Below 20°.

Game	Per pound gross	....	....	....	....	....	......	⅛c. per month.
Venison and Poultry	" " "	....	....	....	....	....	......	" " "
Quails	" dozen	....	....	....	....	....	......	15c. per season.
Fish		25° to 30°	....	....	....	....	......	⅛c. to ¼c. per mo.

The above table will serve as a guide until the cost, based on running expenses to suit your particular trade can be established to suit demand of locality.

TESTIMONIALS

FROM

USERS OF OUR ECLIPSE ICE-MAKING AND REFRIGERATING MACHINERY IN COLD STORAGE HOUSES.

MACHINE COOLING THE ENTIRE STORAGE OF THE FINEST MARKET IN THE UNITED STATES FOR TWO YEARS PAST.

Office of THE WASHINGTON MARKET COMPANY,
Centre Market, Seventh Street Wing.

WASHINGTON, D. C., *Nov.* 28, 1888.

FRICK COMPANY, Waynesboro, Pa.

Gentlemen:—In answer to your inquiry regarding the construction and economy of the Refrigerating Machine furnished by you for the Washington Market Company, I will say that the ice boxes used by one hundred butchers in our Central Market were removed in July, 1887, and all our dealers concede that the dry cold air produced by mechanical refrigeration is far superior to the moist cold air produced by the use of ice.

Since the plant furnished by you has been put in it has accomplished good results, and the work has been done economically and in a satisfactory manner.

Respectfully, N. G. ORDWAY,
Pres't Washington Market Co.

Office BALTO. CITY COLD STORAGE CO.,
No. 126 S. Eutaw St. JAS. T. HODGES, *Manager.*

BALTIMORE, MD., *June* 17, 1886.

Messrs. FRICK COMPANY, Waynesboro, Pa.

Gentlemen:—We have for some time had our new cold storage warehouse and machinery in full operation, and at your request will give you our opinion of your new Improved Refrigerating machine which you furnished and erected in our buildings this spring. Realizing the great importance, in fact we might say recognizing that the machine that produces the cold is the most important factor in assuring the continued success of an enterprise of this kind, our company, when they reorganized and came to consider the purchase of a refrigerating machine, were of one opinion, and that opinion was to secure, by all means, the best one in the market. Your machine, while comparatively new and unknown, when presented to our committee, was unhesitatingly accepted as the best we had yet seen, and in actual operation it has exceeded our expectation. We were really treated to a surprise and had an unusual experience in our purchase, we received even a better machine than we expected. The machine is much admired by all who have a taste for or profess to understand machinery. It is a heavy and substantial machine, almost to a fault, runs as smooth as a clock. We feel no uneasiness, and with the thousands and thousands of dollars worth of perishable goods packed in our store rooms, do not have a single anxious moment; in fact we feel as safe and our customers can rely upon the preservation of their goods with the same confidence in the hot dog days that would be theirs if they knew that their products were snugly packed in an Arctic snow bank, cool and dry, with the mercury perpetually out of sight or in the bottom of the thermometer. We, of course, regulate the temperature of the rooms and control the same exactly to suit the kind and class of goods stored therein. The capacity of the machine is such that we run it but ten to twelve hours daily. We will be pleased to show any person interested through our establishment and have them inspect the machinery, which needs no praise at our hands when once seen.

W. C. WILKINS, *Pres't.*

EMIL WINTER,
Manufacturer of and Dealer in
TALLOW, OLEOMARGARINE OIL, STEARINE AND HIDES,
306 to 318 East Street.

ALLEGHENY, PA., *Nov.* 1, 1889.

FRICK COMPANY, Waynesboro, Pa.

Gentlemen:—In reply to your letter as to the 35-ton Refrigerating machine which you erected at our new abattoir, Herr's Island, we will say that up to the present time we have gotten very good results. We are still building and adding to our works, and feel sure that the machine will take care of the increased space over contract, hence we have not yet given the machine the thorough test that we expect to. After we have tested the machine on the entire space thoroughly, we will be pleased to give you a correct letter as to the duty and efficiency, coal, water and ammonia used in operating the machine. We remain,

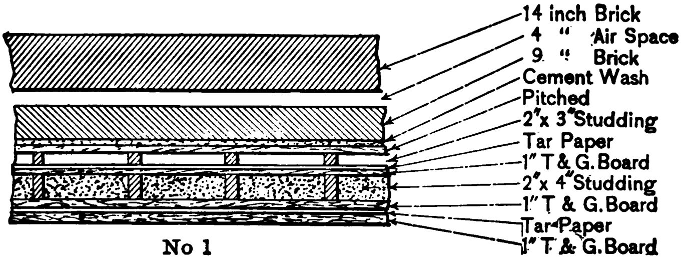
Yours respectfully, WINTER & DELLENBACH.

REFERENCES FOR OUR ECLIPSE REFRIGERATING MACHINERY IN COLD STORAGE HOUSES.

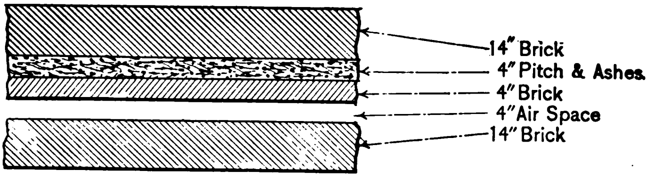
J. C. Shafer & Co., Baltimore, Md........	40	ton	Refrig'ing	capacity.	
C. Cassard & Sons, Baltimore, Md	25	"	"	"	
Baltimore City Storage Co., Balto., Md...	32	"	"	"	
Armour Packing Co., Kansas City, Mo...	100	"	"	"	
Shallcross & Son, Coatesville, Pa.........	15	"	"	"	
Washington Market Co., Wash., D. C...	32	"	"	"	
Armour Packing Co., Kansas City, Mo...	125	"	"	"	2d order.
Francis Whittaker & Sons, Wichita, Kan..	125	"	"	"	
Emil Winters, Pittsburg, Pa.............	37	"	"	"	
Geo. H. Hammond & Co., Omaha, Neb...	150	"	"	"	
Chicago Pack. & Prov. Co., Chicago, Ill...	150	"	"	"	2d order.
Steelton Store Co., Steelton, Pa..........	10	"	"	"	
Pittsburg Meat Supply Co., Allegheny, Pa.	50	"	"	"	
J. Vogle & Sons, Cincinnati, Ohio........	50	"	"	"	
John Hately, Chicago, Ill.................	65	"	"	"	
Geo. Hammond & Co., Hammond, Ind..	150	"	"	"	2d order.
Chicago Packing and Prov. Co., Chicago,	150	"	"	"	
Calumet Canning Co., Hammond, Ind...	32	"	"	"	
Westchester Cold Storage Co., West Chester, Pa	10	"	"	"	
Frank Seifried, Louisville, Ky	7	"	"	"	

Others in process of erection.

INSULATING BUILDINGS AND COLD STORAGE ROOMS.



No 1



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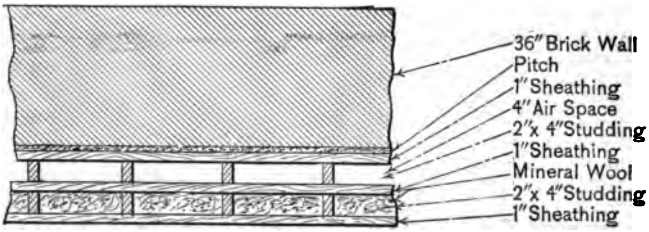


No 3

Various Approved Methods.

INSULATION OF BUILDINGS.

The insulation of buildings used for the preservation and storage of substances subjected to Mechanical Refrigeration is a matter of vital importance when viewed from an economic standpoint. It is true that by employment of a large surplus of refrigerating power, errors of insulation, with its entailed great loss of negative heat, is wastefully overcome and the desired amount of cooling work accomplished; but this is a bad way to reach a result, for the reason that it is a preventible loss. Poor insulation is like paying interest on borrowed capital, and a never-ceasing and useless drain upon the machinery and pocketbook of the owner.

PERFECT INSULATION

is when there is absolutely no transfer of heat through the walls of a building; but this is scarcely possible. If it were, once cooling of the contents of the room would suffice; for there being no loss, they would continue at the same temperature for an indefinite period. If all articles placed in the room thereafter were previously cooled to the temperature of the room before placing therein, no work need be done thereafter in the room itself.

A large percentage of the actual work of a Refrigerating Machine is required to make up for transfer of heat through the walls, floors and ceilings occasioned by poor insulation, and the amount may be experimentally determined by proper instruments.

Owing to difference in construction, exposure and insulation of buildings, we find a great difference in economy of performance and work done by the same machine in use by different parties in the same line of business; and we here add, founded upon general experience and careful observation, that what a given machine and apparatus will do in one place is no certain guide for another place somewhat similar. What some of our competitors claim to do under certain exceedingly favorable conditions they cannot duplicate under seemingly the same requirements, in a different locality. The insulation, exposure and method of handling the business is mainly responsible for the difference.

APPROVED PLANS FOR INSULATION.

Several plans for insulation, all having been used with success, are shown upon page 146, and from this wide range there will be no difficulty in making a selection to suit your proposed expenditures. We, however, urge you to adopt the best.

TABLE GIVING COMPARATIVE VALUE OF DIFFERENT INSULATING MATERIALS.

NOTE.—This table gives the conducting power for each *square foot* of surface, and the comparative value is expressed in the number of *units of heat lost* by transmission through them *per hour*. They are arranged in the order of their merit.

	Units Lost.		Units Lost.
Copper	515.	Brick dust	1.33
Iron	233.	Coke dust	1.29
Zinc	225.	Cork	1.15
Marble	28.	Chalk powder	0.87
Stone	17.	Charcoal powder	0.64
Glass	7.	Straw chopped	0.56
Brick work	5.	Coal dust	0.54
Plaster	4.	Hemp canvas	0.41
Double windows	3.6	Muslin	0.40
Oak wood	1.7	Writing paper	0.34
Walnut wood	0.8	Cotton	0.32
Pine wood	0.75	Air confined	0.3
Saw dust	0.55	Gray blotting paper	0.27
India rubber	1.37		

Tar paper, pitch, fine cinders, hair felt, etc., are used with success.

One of the conditions to be taken into account in dealing with low temperatures is the facility with which moisture from the air will be absorbed by some of the above substances and lead to decay, softening and acid fermentation. For this reason granulated cork, pitch, tar paper, wood well shellaced, or substances that will resist moisture, are the favorites. *Use only substances that have no strong odor or have same deodorized.*

CHAPTER IX.

MANUFACTURE OF ICE, *CAN SYSTEM.*

THIS INFORMATION YOU HAVE ALL BEEN TRYING TO FIND IN BOOKS, BUT WITHOUT SUCCESS.

PLAN OF 50-TON ICE FACTORY, CAN SYSTEM.

PHOTOGRAPH INTERIOR VIEW OF SAME.

WHAT IS NEEDED TO ESTABLISH AN ICE FACTORY.

THE MACHINERY OF AN ICE FACTORY.

INTERIOR VIEW OF A FREEZING TANK, CAN SYSTEM.

WHAT A COMPLETE PLANT CONSISTS OF.

TABLE OF COST OF OPERATING ICE FACTORIES.

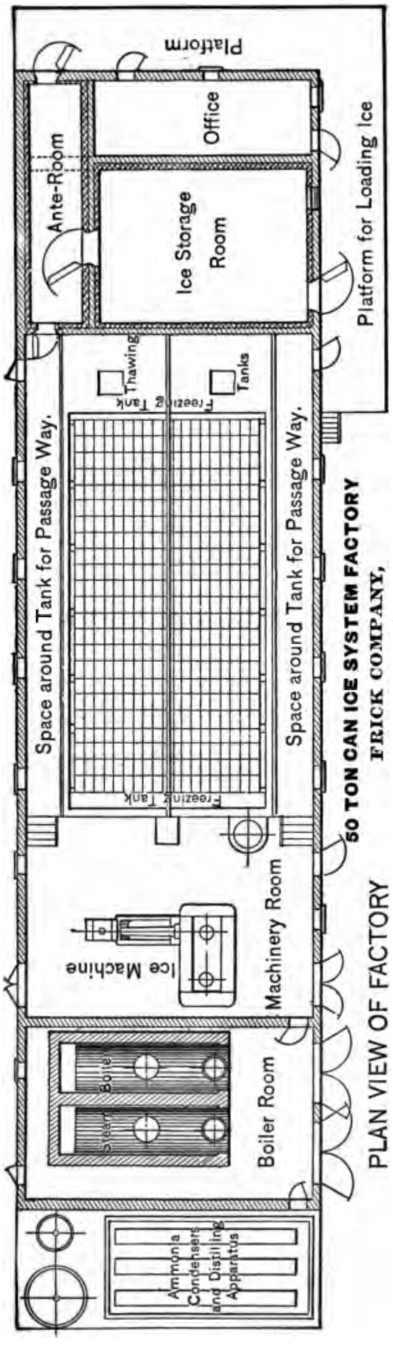
NUMBER OF MEN EMPLOYED, ETC.

COMPLETE SPECIFICATION OF AN ECLIPSE PLANT.

TESTIMONIALS AND REFERENCES.

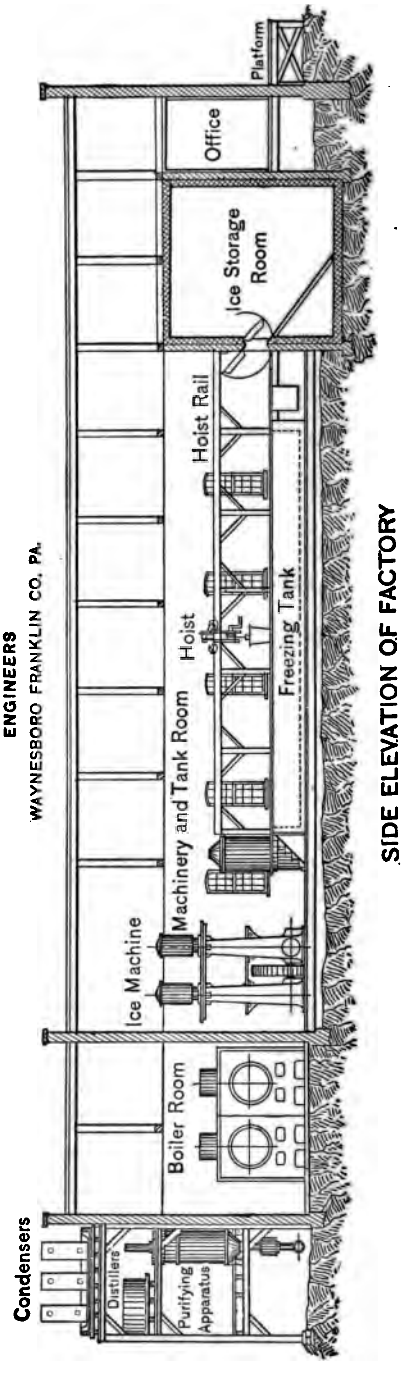
READ WHAT A CHEMIST SAYS OF OUR DISTILLED WATER.

SEE SMITH PLATE ICE SYSTEM, CHAP. XI.

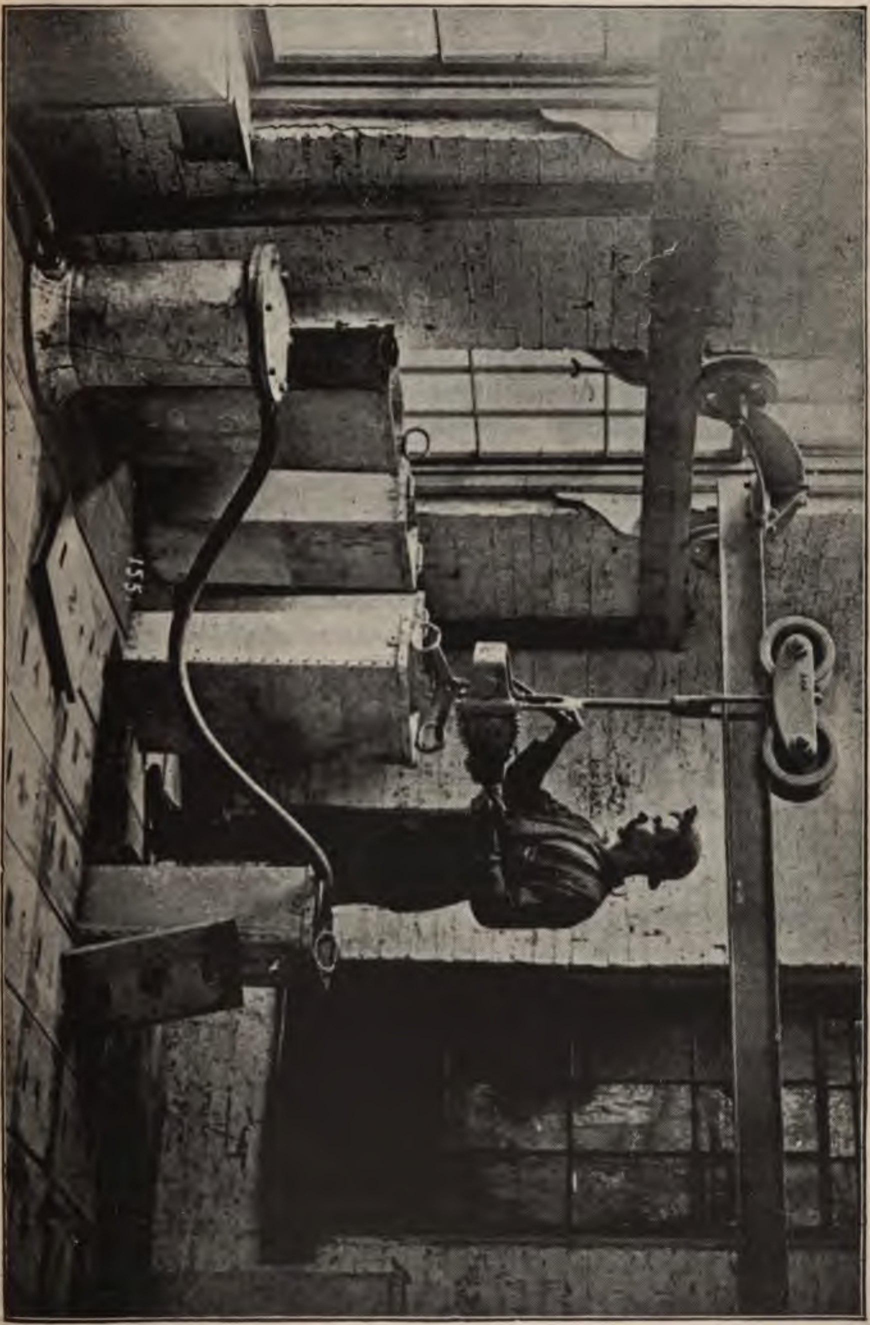


PLAN VIEW OF FACTORY

50 TON CAN ICE SYSTEM FACTORY
FRICK COMPANY,
ENGINEERS
WAYNESBORO FRANKLIN CO. PA.



SIDE ELEVATION OF FACTORY



Ice Factory, showing Hoist.

ICE MANUFACTURE.

The manufacture of ice upon a large scale is found to be profitable and offers special inducements as a remunerative investment for capital, for the reason that it can be produced so cheaply by our " Eclipse " Ice-Making Machinery that, except in the higher Northern latitudes, natural ice cannot compete with the machine product, either in cost or quality.

PURITY OF MACHINE-MADE ICE.

From a sanitary or hygienic point of view the wholesomeness, cleanliness and clearness of ice made by our machinery has attracted the attention of physicians, who recommend it instead of natural ice.

MACHINE ICE MADE OF PURE WATER.

It is not generally known that the water used for freezing in our ice moulds is chemically pure (distilled water), and of course free from all organic matters, disease germs, etc., which are seen in natural ice and claimed by physicians to cause diphtheria, fevers, and kindred diseases. It is rare that natural ice can be found entirely free from impurities, as much of it must be gathered from filthy streams, stagnant ponds, canals, shallow and still waters, or basins into which sewers have emptied, or contaminated by receiving the surface washings of the soil, which is at all times laden with deleterious organic and decomposed animal matters.

The best natural ice is taken from the potable waters of the great Northern rivers and lakes, or large and deep bodies of water, which afford, by reason of the great severity of the winters, an immense harvest, and, under favorable conditions, clear crystal ice. Even this ice, under the microscope, is teeming with organic life, and is far from being as pure and wholesome as ice manufactured from distilled waters.

While Nature manufactures ice without cost to any one, the cost of cutting, handling, transportation, loss by waste and meltage, and expense of storing when gathered from the ice-producing localities of the North, is so great that, even in cities as far north as New York, Philadelphia, and Chicago, manufactured ice can be produced and sold at a handsome profit, and in direct competition with the famous "Northern lake" and "Kennebec ice," as practically demonstrated by many ice dealers who now profitably operate ice factories.

An analysis of the reasons why ice can be manufactured and placed on the market cheaper than that gathered from natural sources will be interesting, aside from a consideration of the unquestioned superiority of the machine-made article.

Manufactured ice has one advantage among others, of being made in the very market in which it is sold and consumed, hence suffers no loss and occasions no extra expense for transportation and storage. The actual demand is supplied from day to day by making the ice as called for, drawn directly from the freezing moulds without waste, and supplied to the customers without intermediate storage and loss by meltage in transportation, which ranges from 20 to 75 per cent.

EXPENSE OF MANUFACTURE.

The operating expenses of an ice plant of a given capacity can be predetermined, as all expenses connected with the factory are fixed quantities for given rates of production. It is in every sense a routine business, with no greater contingencies and as susceptible of exact calculation as the business of pumping a given quantity of water.

The more extensive or the greater the capacity of the plant, the less the cost per ton of production, but even plants of a daily capacity of five tons per day prove remunerative investments.

Aside from the influence of the capacity of a plant, the cost of making ice also varies slightly with different localities, being affected by cost of fuel and labor, the difference being so little, however, that we find ice manufactured and sold in the South quite as cheaply as natural ice in the Northern cities. It is a matter of congratulation that the machine-made ice has supplanted natural ice wherever introduced. It may not be generally known that manufactured ice will last longer than natural ice, owing to its density, absence of air, and low temperature.

METHODS OF MAKING ICE.

We use two methods of making ice. One known as the "Mould" or "*Can System.*" See page 160. The other as the "*Smith Patent Plate System,*" which we will explain at length in following chapter.

As so many questions are asked by our customers and others interested, for information relating to the manufacture of ice, we here explain the subject at sufficient length and give considerable information on the subject of ice-making, illustrating with special engravings taken from photographs, for the purpose of posting the reader prior to corresponding with us.

First taking up the manufacture of ice on the "Can or Plate System," we answer the first question.

WHAT IS NEEDED TO ESTABLISH AN ICE FACTORY?

The first and most important thing is a market for the ice. While the home or local demand may not be sufficient to justify entering the business, your proposed ice factory may be so fortunately located that it may serve as a centre of supply for outlying towns easily reached by railroad or wagon deliveries, and thus the aggregate demand of the vicinity may justify the erection of a plant of not less than two tons capacity. (This size, however, will depend upon price of ice obtainable.) It is well known and an encouraging thing to know that the demand for ice grows larger year by year, and the introduction of first-class manufactured ice in a locality is simply the beginning of a constantly increasing and substantial business.

WATER FOR USE IN THE FACTORY

is the next most important consideration. Be sure that you can obtain a reliable supply of water at all times and all seasons, calculating upon a basis of at least three to four gallons per minute for every ton of proposed ice-making capacity. Water should be suitable for feeding boilers, and is needed for condensing the ammonia, filling ice moulds, distilling and cleaning. Preferably, the water should be as cold and pure as possible, and if taken from the earth from an artesian or deep well, all the better, because colder. In our system of making ice the water is greatly economized, as the same water is used first on the *ammonia condenser*, then again for *distilling*, then pumped from the distiller overflow into the *steam boiler*, the steam therefrom being used in the *engine*, and afterwards *condensed* in the distiller, and finally, after thorough purification, utilized to fill the *ice moulds*, hence the total water supply is reduced to a minimum.

ICE-FACTORY BUILDINGS.

These may be made of wood or brick, depending upon the building regulations or fire restrictions of the city or locality, as well as upon the ambition and means of the owner. In most cases, a plain and a well-built wooden building is used, the engraving on page 150 giving a good idea of the requirements. The building should be divided into the following compartments: boiler room, engine or ice-machine room, and tank room, ice-storage house, having an anteroom, and a business office.

The condensing and distilling apparatus may be placed upon the roof, or in a special room; in either case they should be protected by a roof, with open sides of lattice or screen work through which air can circulate. A convenient platform for loading into wagons and weighing the ice is also required.

Special cold-storage rooms for preserving butter, eggs and perishable products may be added to the premises with profit, if the locality offers any inducement to provide for this kind of business.

THE MACHINERY OF AN ICE FACTORY

is necessarily expensive, and this brings us to a point where a few words of explanation and caution are appropriate. We cannot emphasize our remarks too strongly, when we say: "*Have nothing to do with cheap Ice-Making Machinery,*" and if you cannot afford to fit up your Ice Factory as it should be, and buy the best in the market, drop the business at once and save future disappointment and loss.

Our particular reasons for italicizing the above paragraph is, that the inexperienced are imposed upon by a class of so-called Ice-Making Machine Builders *who name prices to you lower than the actual cost of the material used in a strictly first-class plant.* Some of these parties know just what they are about and depend upon the ignorance of the buyer in not discovering the fraud until he has paid for the plant. Others, of limited experience, actually do not know what is really needed and, quite as ignorant of the business as their would-be customers, make mistakes, which said customers in the end pay for, while others, who ought to know better, cut down materials and skin down at all points, to make the first cost low, simply to make sales, without any regard to their own or customers' best interests.

The following points are well to bear in mind in purchasing an Ice Plant:—

Deal only with experienced builders of solid reputation who have ice-making plants to show in successful and actory operation. Look at durability, quality, quantity, economy and cheapness in the end, and care little for first cost, and see that when you buy an ice plant it will make the guaranteed output in midsummer, and not just squeeze through under what is called by experts a "snap test," in comparatively cold weather.

BOILER POWER.

Insist upon ample boiler power, and a point worth knowing to your future advantage, especially on larger plants, is to use two boilers, either of which will run the machinery while the other is being repaired or cleaned. This is well to take into consideration, as ice factories are run day and night (continuously), as with a single boiler it means a stoppage of your whole factory in case of accident or necessary periodical cleaning of boilers. See engraving of boiler, last pages of this book.

ICE CANS OR MOULDS.

Where the Can System is used, the number of moulds allowed per ton of ice made per day is important in its bearing upon the quality of ice produced as well as quantity.

Some builders, in order to cheapen their plants, use a small allowance of cans, necessitating working the bath at very low temperatures, freezing too rapidly, thus giving the ice an opaque appearance. We recommend the following allowance: Ice 8 inches thick, freezing to occupy 36 hours; ice 11 inches thick, at the rate of 60 hours, and temperature of bath, 10° to 14° Fah. As a rule, the higher the bath temperature and the slower the process of freezing, the finer and clearer the ice. The larger the allowance of cans, the greater the reserve and the ability to push a plant above its rated capacity. The number of cans furnished is to an expert a good index of the efficiency of the plant.

The sizes of cans in most common use are shown in the following table:

No.	1	can,	8½ x 15 x 32,	weight of	cake,	100	lbs.,	No.	18	Iron.
"	2	"	8½ x 16 x 44,	"	"	150	"	"	18	"
"	3	"	11 x 11 x 32,	"	"	100	"	"	18	"
"	4	"	11 x 22 x 32,	"	"	200	"	"	16	"
"	5	"	11 x 22 x 44,	"	"	300	"	"	15	"

All cans have wrought-iron bands, are well braced, rivsted and soldered, smooth inside, galvanized throughout, and standard taper. See photograph of can.

TRAVELLING CRANE AND ICE CAN HOIST.

We furnish a free-moving light travelling crane for at least each ten ton tank capacity, with geared hand hoist and brake, making it easy work for one man while on watch to take care of 10 to 15 cans per hour. See engraving of Hand Hoist, page 151.

ICE-MAKING MACHINERY PROPER.—ADVICE.

Our Gas Compressor Pumps are single-acting, thus enabling you to run one pump when you wish to examine the other; this is of great value in case of accident, as you can keep at work while repairing the other pump. A single-acting pump will handle more gas than a double-acting one, because it has less waste room at valves and cylinder ends, which space allows expanding back of compressed gas, and is a loss from useless work; the condensing pressure does not come upon the piston rod stuffing box, in the single-acting there is less friction and loss of ammonia than in double-acting pumps. See page 46 for full description.

STEAM ENGINE AND PUMP CAPACITY.

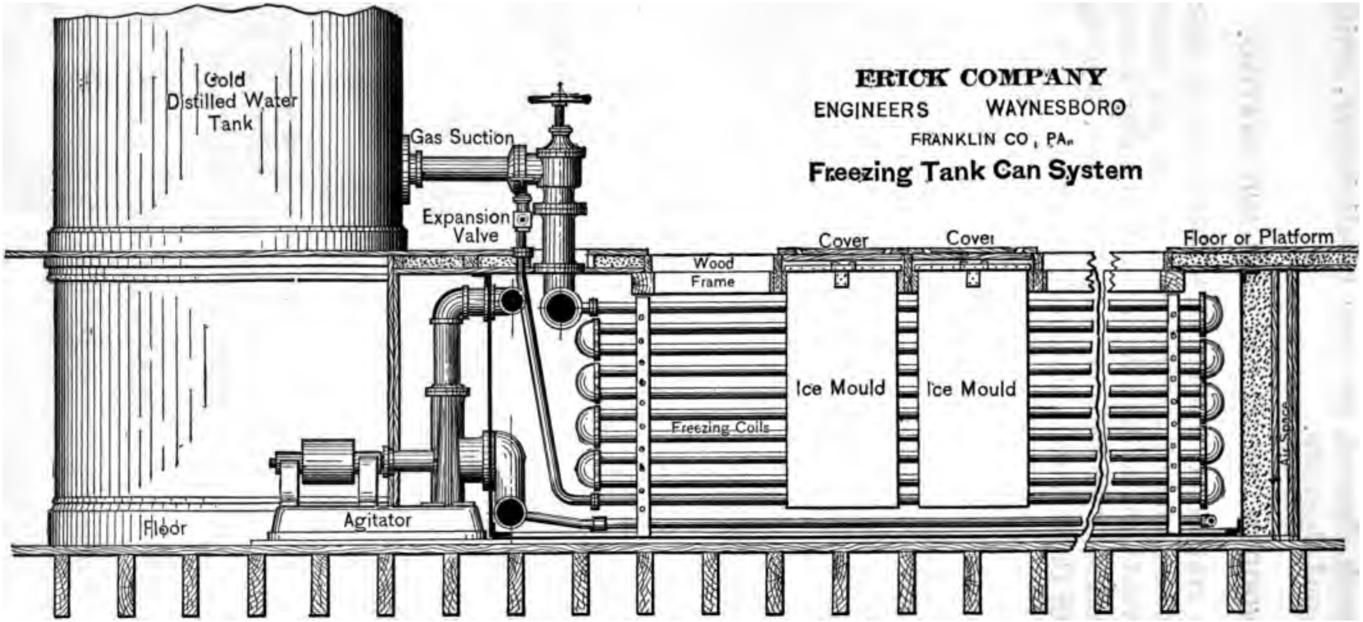
We furnish all our Compressor Pumps with a first-class engine to drive the pumps under moderate steam pressure, and the gas compressors are of such size that the machine does not have to run at high speed, say above 60 revolutions on smallest plants, to turn out the guaranteed output of ice. See engraving of machine with Corliss engine, page 42.

FREEZING TANK.

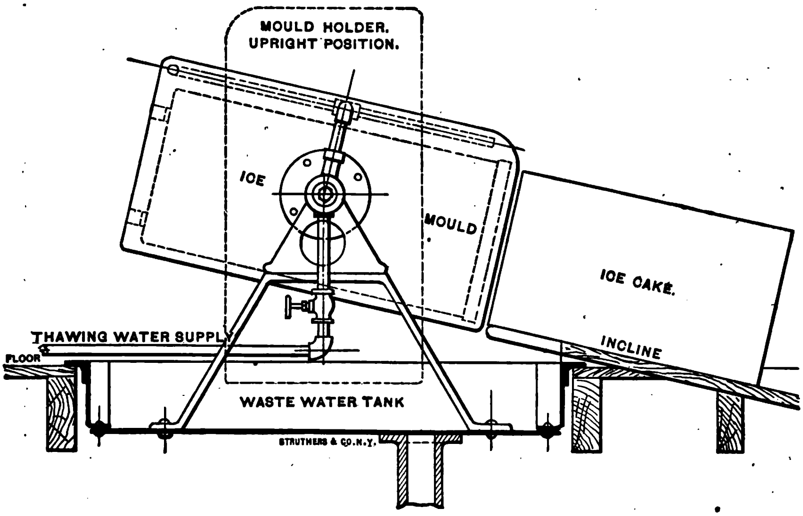
The Freezing Tank is in all cases made of iron or steel, and well coated with water-proof paint. Wooden tanks, while much cheaper, are very unsatisfactory, owing to leakage and short life.

WOODEN COVERS FOR CANS AND GRATING.

The grating or framework to hold cans in tank are made of oak, and covers thoroughly made and numbered for convenience in drawing cans in regular order, the framework well jointed and screwed together. See engraving of our Cage Work and Covers, page 160.



Sectional Side View



AUTOMATIC THAWING APPARATUS FOR ICE MOULDS.

A COMPLETE ICE FACTORY PLANT CONSISTS OF THE FOLLOWING.

MACHINE SYSTEM.

Ice machine proper, with a pair of single-acting gas compressor pumps, and steam engine with separators, gauges and connections.

LIQUEFYING SYSTEM.

Ammonia condenser (submerged or atmospheric), with liquefying coils, system of ammonia pipes, stop-valves, receiver and special fittings.

NOTE.—The above two systems together are called the compressor side.

ICE-FREEZING SYSTEM.

System of tanks, ice moulds, evaporating coils, wood grating and covers, hoisting and travelling cranes, thawing apparatus, equalizing or agitating apparatus, and pipe distribution, with transmission shaft, belts and pulleys.

DISTILLING SYSTEM.

Distilling and purifying system, as noted on page 184, with all connections, the complete apparatus being illustrated on page 178.

STEAM BOILER AND PIPE SYSTEM.

Steam boiler plant, with feed pumps, steam, water, and exhaust connections.

WATER SUPPLY SYSTEM.

Water pumping system, with well pump, pipes and fittings.

COLD STORAGE ROOM SYSTEM

Storage rooms, if used, call for additional machinery, such as brine tank and pump, air cooling pipes in storage rooms, stand pipes, etc.

A Special Distilling Apparatus, Exhaust Evaporator is shown on page 182, and is recommended for producing distilled water directly from water without passing through the boiler and engine in the form of steam, the heat of the exhaust steam being utilized in this apparatus for evaporating the water from any outside source, the product being distilled water absolutely free from and out of contact with engine cylinder oil. The exhaust steam is condensed in the evaporator and can be pumped back into the boiler, a saving being thereby effected in wear and tear of boiler. This machine is especially useful in case of bad water for feeding boilers. The same water after purification can be used in the boiler over and over again. In case of being forced to use salt water for condensing the ammonia gas, and having only a small supply of fresh water just sufficient for filling cans.

HOW LARGE AN ICE-MAKING PLANT CAN WE SUPPLY?

We can furnish Ice factories complete of any capacity required, from five tons to one thousand tons or more, on either the Can or Plate System, and a single machine of capacity to make 100 tons of ice. The larger the plant and greater its capacity, as previously stated, the less the ice costs per ton. This is because the expense for skilled labor decreases in proportion to size. The same organization of skilled men will operate a 100-ton factory that are required for 75 tons.

GENERAL DESCRIPTION OF AN ICE FACTORY.

HOW ICE IS MADE BY THE CAN SYSTEM.

The engraving on page 160 shows a section of a can freezing tank, and discloses the interior arrangement thereof, showing the arrangement of ammonia evaporating pipes, ice moulds, framework for holding the cans in position with wooden covers.

EVAPORATING COILS.

Parallel rows of ammonia pipes with space between each set to admit of a row of moulds being submerged in the cold brine with which the tank is filled, the water being frozen by the method described in the chapter treating on the theory of refrigeration. The contents of the cans are frozen into a solid sparkling mass of ice in from 36 to 60 hours, depending upon thickness of mould and temperature of brine.

THE ICE MOULDS

we make in four sizes, 100, 150, 200 and 300 pounds. The actual weight of cake is about 10 per cent greater, however, to allow for wastage. The demand of the locality influences the selection of the size of cake and determines the weight to be used.

TAKING THE ICE OUT OF THE MOULDS.

A suitable hoisting arrangement, travelling upon iron rails, over each tank is used for lifting the moulds out of the tanks, and they are then carried by the hoist to a thawing device and immersed for a moment in water of say 50 to 70 degrees. The mould is then tipped over an inclined run-way, the cake of ice easily slipping out of the can and sliding down the run-way through a trap into the ice-house or anteroom, where it is temporarily stored, awaiting delivery to customers.

RUNNING AN ICE FACTORY.

It is important in ice-making, where the greatest production with the least possible cost is desired, to run the plant *day and night, making the operation continuous.* Not only this, but the best conditions to insure the best quality and greatest quantity should be observed and uniformly held. For instance, in drawing the ice, *it must be done with regularity, so many cans each hour, day and night, and the drawing uniformly distributed over the whole area of the tank.* To assist in this we brand a figure upon each cover, and a little practice will soon enable the tankmen to keep record of their work. It is hardly necessary to suggest the reason why the ice should be drawn systematically, the machine run at regular speed, steam pressure, water supply, boiler feed, and all temperatures maintained, as near as possible, uniform.

CLEANLINESS.

Keep all parts of the apparatus clean and in good order. Let nothing become foul or dirty about the distilling apparatus, ice cans or tanks. Means are provided for purging the entire distilling system by steam, and the use of a scrubbing brush and harmless solvents are recommended. Change charge in your filters as often as required.

THE ICE FACTORY CREW,

divided in two watches, each 12 hour watch, for instance, on a 50-ton ice plant, consists of one engineer, one oiler, one fireman and coal passer, three tankmen, one ice-house man and one general helper on each watch.

OPERATING EXPENSES OF FACTORY

are made up of cost of fuel, light, oil and waste, slight loss of chemicals, sundry small repairs, salary of superintendent and engineer, with wages of fireman, tankmen and other labor. It is a paying investment to employ good men and best fuel obtainable. See table, page 166.

ICE MANUFACTURE.

APPROXIMATE COST OF OPERATING ICE FACTORIES.

Tons Ice per Day.	Engineers $1.50 to $5.00 per Day.		Night Eng'r or Oilers $1.50 per Day.		Firemen $1.50 per Day.		Tankmen and Laborers $1.00 per Day.		Pipe Fitter or Machinist $2.50 per Day.		Coal 15 Cts. per Cwt., or $3.00 per Ton.		Oil Waste, Lights and Sundries.	Daily Operating Expenses.	Ice per Ton.
1	1	$1.50		......		......	1	$1.00		......	900	$1.35	$0.50	$4.35	$4.35
2	1	1.50		......		......	1	1.00		......	1.500	2.25	.50	5.25	2.63
3	1	2.00		......		......	1	1.00		......	1,800	2 70	.50	6.20	2.10
4	1	1.75	1	$1.50		......	1	1.00		......	2,200	3.30	.75	8.30	2.08
5	1	2.00	1	1.50		......	2	2.00		......	2,500	3.75	1 00	10.25	2.05
6	1	2.00	1	1.50		......	2	2.00		......	2,700	4.05	1.00	10.55	1.76
7½	1	2.00	1	1.50	1	$1.50	2	2 00		......	3,200	4.80	1.25	13.05	1.74
10	1	2.50	1	1.50	2	3.00	2	2.00		......	3,600	5.40	1.25	15.65	1.57
12½	1	2.50	1	1.50	2	3.00	2	2.00		......	4,500	6.75	1.25	17.00	1.37
15	1	2.50	1	1.50	2	3.00	3	3.00		......	5,000	7.50	1.50	19.00	1.27
18	1	2.75	1	1.50	2	3.00	3	3.00		......	5,500	8.25	1.80	20.30	1.15
20	2	4.50	1	1.50	2	3.00	3	3.00		......	6,000	9.00	2.00	23.00	1.15
25	2	5 00	1	1.50	2	3.00	4	4.00		......	7,500	11.25	2.50	27.25	1 09
30	2	5.00	2	3.00	2	3.00	4	4.00		......	9,000	13.50	3.00	31.50	1.05
35	2	6.00	2	3 00	2	3.00	5	5.00		......	10,500	15.75	3 50	36.25	1.03
40	2	6.00	2	3.00	2	3.00	5	5.00		......	12,000	18.00	4.00	39.00	1.00
45	2	6.00	2	3.00	2	3.00	6	6.00		......	13,500	20.25	4.50	42.75	1.00
50	2	6.50	2	3.00	3	4.50	6	6.00	1	$2.50	15,000	22.50	5.00	50.00	1.00
55	2	6.50	2	3.00	3	4.50	7	7.00	1	2.50	16,500	24.75	5.50	53.75	1.00
60	2	7.00	2	3.00	4	6.00	7	7.00	1	2.50	18,000	27.00	6.00	58.50	1.00
65	2	7.50	2	3.00	5	7.50	8	8.00	1	2.50	19,500	29.25	6.50	64.25	1.00
70	2	7.50	2	3.00	5	7.50	8	8.00	1	2.50	21,000	31.50	7.00	67 00	.99
75	2	8.00	2	3.00	5	7.50	10	10.00	2	5 00	22.500	33.75	7.50	74.75	.99
80	2	9.00	2	3.00	5	7.50	10	10.00	2	5.00	24,000	36.00	8.00	78.50	.98
90	3	10.00	2	3.00	6	9.00	11	11.00	2	5.00	27,000	40.50	9.00	87.50	.96
100	3	10.00	2	3.00	7	10.50	12	12.00	2	5.00	30,000	45.00	10.00	95.50	.95

The rate of wages and cost of fuel in the locality where machinery is to be used will change above figures slightly. ***The total allowances named are large, which fact will be recognized by experts.***

CAN ICE PLANT SPECIFICATIONS.

WHAT WE FURNISH WITH OUR STANDARD PLANT.

COMPRESSION SYSTEM.

One or more pair of single-acting gas compressors, complete, with Corliss or cut-off steam engine to drive same, necessary ammonia condenser, oil separator, traps and all connections complete.

FREEZING TANK SYSTEM.

Suitable freezing tanks made of iron, size as required to accommodate cans, with wood framework and covers, properly branded with large figures.

Each freezing tank to be complete and fitted with ammonia evaporating coils, stands, bends, expansion valves, headers, couplers, and fittings.

An ample allowance of galvanized iron freezing cans, size and weight of cake as agreed. All cans riveted and soldered, and well braced with one-quarter by one and one-half inch band at top.

Each tank to be fitted with brass-lined agitator or pump, with pipes or fittings, to secure an equal freezing in all parts of the tank, with transmitting shafting, pulleys, hangers and belting for agitator complete. Larger plants having separate steam engine.

Suitable geared hand hoists and travelling cranes for handling ice cans, with iron work complete, by power or hand.

Can-filling devices, with hose to reach any can in each tank.

Thawing tanks or apparatus and connections.

Also the following apparatus for distilling and purifying exhaust steam to make water for filling ice cans:

Grease separator fitted in main exhaust pipe to remove oil used in steam engine.

Exhaust steam filter fully charged.

Back-pressure exhaust valve.

Distiller or exhaust steam condenser of submerged or open air style, with or without tank, or combined filter separator and condenser.

Purging water regulator or skim tank, with steam coil and float valve for same, complete.

Distill water filter and deodorizer, with full charge of animal or sugar charcoal.

Distill water cooler.

Water storage tank with "forecooling" coil.

Supplemental filter, with charge of special filtering material.

And complete pipe connections for above apparatus. All distilling apparatus of an improved construction and made of heavy galvanized iron, caulked and riveted, to be capable of condensing and purifying required tons of steam in 24 hours.

STEAM BOILERS.

When furnished by us of horizontal tubular style, to be fitted with full flush fronts, fixtures and mountings, including everything necessary for setting boiler (except mason work and material), needed feet of smoke stack, with damper, guy rods and hood.

Boiler plant we guarantee to be of ample capacity to furnish steam to operate ice-making machine and all pumps.

Needed steam pump and connection—main steam and exhaust pipe for engine, and water distribution with water pumps if included.

ERECTION OF MACHINERY.

We furnish one competent erecting engineer to superintend the erection, with full kit of erecting appliances; but purchaser is required to furnish one engineer to assist in erecting, that he may become qualified in putting together and running the machinery.

Complete plans furnished for foundations (and when agreed, of building to accommodate machinery).

Foundation bolts for machine, with anchor washers and templates for setting.

GUARANTEES.

We guarantee the following performance :

That each ice plant will, when in full operation, make tons named of merchantable ice per day of 24 hours in midsummer, when run continuously and properly managed.

We guarantee workmanship and materials for one year, provided no disarrangement is caused by carelessness, incompetency, or want of attention of person in charge, and if run according to our instructions.

We guarantee the amount of water required for use on the refrigerating machine condenser and jackets and distilling apparatus, not to exceed 3½ gallons of condensing water per ton of ice per minute, at a maximum temperature of 75 degrees Fah.

Purchaser will be required to furnish the following:

To supply and deliver at the various parts of the apparatus, water suitable for making ice as required ; all necessary labor for hoisting, moving and placing machinery in position ; to properly insulate and furnish wood curbing for brine tank ; needed salt to make brine solution in tank, and ammonia for charging machinery, all foundation work, masonry, carpenter and woodwork and buildings, and to pay all freight and other transportation expenses.

Payments. One quarter cash with order ; one quarter cash on arrival of machinery on cars at nearest point ; one quarter cash after thirty days test, and the balance by interest-bearing note, payable two months after termination of test, *or as may be otherwise agreed.*

REFERENCES FOR OUR ECLIPSE ICE-MAKING MACHINERY IN ICE FACTORIES.

F. L. Ellis & Co., Hopkinsville, Ky.,	10	ton	Ice Capacity.	Can	system.
Consumers' Ice Co., New Orleans, La.,	100	"	"	Smith plate	"
Little Rock Ice Co., Little Rock, Ark.,	35	"	"	Can	"
Owensboro Ice Mfg. and Cold Storage Co., Owensboro, Ky.,	20	"	"	Smith plate	"
Wm. S. Lurton, Jacksonville, Ill.,	15	"	"	Can	"
Pulaski Ice Co., Pulaski, Tenn.,	4	"	"	"	"
Armour Packing Co., Kansas City, Mo.,	75	"	"	"	"
Ewing & Beall, Uniontown, Pa.,	15	"	"	"	"
S. W. Hill, Allegheny, Pa.,	20	"	"	"	"
Chautauqua Lake Ice Co., Pittsb'gh, Pa.,	40	"	"	"	"
" " " " 2d order,	40	"	"	"	"
West Chester Ice and Cold Storage Co., West Chester, Pa.,	15	"	"	"	"
Cumberland Brewing Co., Cumberland, Md.,	8	"	"	"	"
Steelton Store Co., Steelton, Pa.,	2	"	"	"	"
Parkersburg Brewing Co., Parkersburg, W. Va.,	3	"	"	"	"
Hagerstown Ice Co., Hagerstown, Md.,	20	"	"	"	"
Alberto Malo, City of Mexico, Mexico,	25	"	"	"	"
Germantown Ice Co., Germantown, Pa.,	20	"	"	Can	"

Other plants in course of erection.

TESTIMONIALS

FROM

USERS OF OUR ECLIPSE ICE-MAKING MACHINERY IN ICE FACTORIES.

OFFICE OF WILLIAM S. LURTON,
Manufacturer of
CRYSTAL ICE MADE FROM DISTILLED WATER AND CHEMICALLY PURE.
Cold Storage for Meats, Vegetables, Butter, Eggs, Fruits, Carpets, Furs, and Woolen Goods.
Telephone 138. 611 East State Street.

JACKSONVILLE, ILL., *Oct.* 4, 1889.

FRICK COMPANY.

Gentlemen :—Concerning the engine and refrigerating machinery you set up for me, it works perfectly in every respect; indeed it has exceeded its capacity twenty-five per cent; after running continuously for months it has incurred no expense for repairs; its adjustments were so true that every part of it works faultlessly; the ammonia has not been renewed since the first; the fittings are so exact, we could not wish more perfectly adapted machinery for manufacturing ice and refrigerating; it has been the admiration of every visitor; indeed, "it is a thing of beauty and a joy forever."

Yours respectfully,

Manufacturer of Ice, Jacksonville, Ill. W. S. LURTON.

PULASKI ICE FACTORY CO.,
J. B. STACY. *President.* J. T. OAKS, *Vice-Pres't.* J. H. LIGHTFOOT, *Sec'y and Treas.*

PULASKI, TENN., *Oct.* 15, 1889.

FRICK COMPANY, Waynesboro, Pa.

Gentlemen :—Yours of the 12th inst. received; also yours of the 27th ult., which was inadvertently overlooked.

So far the machinery works charmingly and gives general satisfaction. Our engineer says it is the best he has ever handled, and $2.00 will cover all repairs for the whole season.

Very respectfully,
J. H. LIGHTFOOT, *Treas.*

CRYSTAL ICE AND COLD STORAGE CO.,
Manufacturers of Pure Ice from Distilled Water.
Cold Storage of all kinds of Perishable Goods.

SPRINGFIELD, MO., *October* 23, 1889.

Messrs. FRICK COMPANY, Waynesboro, Pa.

Gentlemen :—In reply to your inquiry of the 12th inst. we will say that we are well pleased with the "Eclipse" Ice and Refrigerating Machine manufactured by your company for our factory at this place.

We believe the design and workmanship of this machine is superior to anything in the market; and by your system of distillation, condensing steam, and passing the water through your improved filters and coolers, the distilled water from which we make our ice is rendered absolutely pure. We have had this distilled water carefully analyzed by expert chemists, and they have never been able to find the slightest trace of impurities of any kind. Enclosed you will find copy of analysis made by Edward M. Sheppard, A. M., of the Drury College, of this place. Since the above analysis he has on two or three occasions further analyzed the water, and the result was always the same—absolutely pure.

Yours truly,
CRYSTAL ICE AND COLD STORAGE CO.

NOTE.—Above plant was partially destroyed by fire, was repaired at our works, and is now running in Hagerstown, Md.

MINERALOGICAL LABORATORY, DRURY COLLEGE.
EDWARD M. SHEPPARD, A. M., Ores and Mineral Waters Analyzed.
Mineralogist and Geologist. Mineral Lands Examined.
1137 Jefferson Street.

SPRINGFIELD, MO., *July* 26, 1889.

CRYSTAL ICE AND COLD STORAGE CO.

Dear Sirs :—I have made a careful chemical analysis of the water which you use for the manufacture of artificial ice. The sample examined I took from one of your freezing cans and in it I have not been able to detect the slightest impurity. Your system of condensing steam and filtering removes all danger of contamination. I regard the ice so manufactured as absolutely pure.

EDWARD M. SHEPPARD.

25 TON ICE PLANT.

LITTLE ROCK, ARK., *September* 5, 1888.

Messrs. FRICK COMPANY, Waynesboro, Pa.

Gentlemen:—I take pleasure in saying that I feel fully repaid for the special trip I made to your works at Waynesboro, and I am free to state that I was very favorably impressed with the thoroughness and substantial character of your work, especially in the Ice and Refrigerating Machine. The fact that I have seen your machines in operation, and have spent time and money investigating all the first-class ice-machines, and have just closed a contract with you for a 25 ton machine, speaks for itself. The result of my recent investigation of all the first-class machines is my choice for the Frick. Yours truly, L. W. CHERRY,

Pres't and Treas. Little Rock Ice Co.

Above plant is making 35 tons per day continuously.

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12 TON ICE PLANT.

HOPKINSVILLE, KY., *October* 9, 1888.

FRICK COMPANY, Waynesboro, Pa.

Gentlemen:—We are pleased to state, in answer to your inquiry, that we are well pleased with the 12 ton ice-making plant you erected for us this spring. The quality of the ice it is making is superior to any manufactured ice I ever saw, and the machine is not pushed to make the quantity guaranteed. The plant is economical in fuel, and there is no perceptible loss of ammonia. We believe we have a model ice plant, and will always take pleasure in showing it to any one interested in such machinery.

Yours truly,

F. L. ELLIS & CO.

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100 TON ICE PLANT.

CONSUMERS' ICE COMPANY,
NEW ORLEANS, LA., *Dec.* 17, 1888.

FRICK COMPANY, Waynesboro, Pa.

Gentlemen:—We have in use at this factory one of your large ice machines, and it gives entire satisfaction.

It has demonstrated a capacity of turning out fifty tons of ice per diem in warm weather, with a coal consumption that compares favorably with any other ice machines in economy. The construction is massive and durable. Yours truly,

N. D. WALLACE, *President.*

CHAPTER X.

CONCERNING WATER AND ITS USE IN ICE FACTORIES.

HOW TO TELL BAD WATER FROM POOR. PROPERTIES OF WATER. EXAMINATION AND ANALYSIS.

DISTILLING SYSTEM. ILLUSTRATIONS OF APPARATUS FOR DISTILLING, PURIFYING, DEODORIZING. ALL ABOUT MAKING DISTILLED WATER.

AMATEUR ICE MACHINE BUILDERS, AND NOVICES WILL LEARN FROM THIS CHAPTER, AND IT MAY HELP THEM ALONG, BUT WHAT MATTER, IT WILL HELP OUR CUSTOMERS TOO.

A CHAPTER CONCERNING WATER.

As pure water is of the first importance in an ice factory both for feeding boilers and ice making, it may be of interest to some of our readers to touch upon this subject in a general way, and discuss the principal properties of water as usually found. To those interested in following the subject at length, we recommend the treatises of J. A. Wanklyn, E. Frankland and C. W. Folkhard on water analysis.

Water is the greatest natural solvent known, hence is rarely found to be pure. It is capable of absorbing every gas and vapor with which it comes in contact.

GASES IN WATER.

Fifty-six cubic feet of water will absorb as much as one cubic foot of air if brought into contact with the same in the form of a spray.

At a temperature of 60 degrees, one cubic ft. of water will absorb 700 cubic ft. of ammonia gas. By weight, water at 70 degrees F. will absorb 50 per cent its weight of ammonia gas, at 80 degrees F. 45 per cent, and at 90 degrees 40 per cent. From this you will understand that water has a great affinity for ammonia gas, and in case of leaky pipes or fittings a great loss of ammonia may occur unnoticed in coils and joints in contact with water, as, for instance, in the condenser or brine tank.

Hydrochloric, sulphuric, carbonic and other gases are also absorbed in goodly quantities—the cooler the water the more gas it will dissolve. These gases must be expelled from water to produce fine ice.

River and canal water generally contains .05 and spring and well water about .07 of their volume of gaseous matter.

SOLIDS IN WATER.

Animal life, organic matters, such as sewage, decayed vegetable and animal matter, poisonous metals, magnesia, lime, carbonates, sulphates, alkalies, earthy salts, chlorine and bromide combinations, etc., are found in quantity.

COMPOSITION AND PROPERTIES OF PURE WATER.

Pure water is composed of 16 parts oxygen and 2 parts hydrogen by weight, one volume of oxygen to two of hydrogen. When pure it is colorless, transparent, and without taste or odor, and should deposit no sediment on standing. Water reaches its greatest density or weight at 39$\frac{1}{10}$ degrees F., with the barometer at 30, and weighs 62.43 pounds per cubic foot. Both below and above this temperature it expands. Its freezing point is 32 degrees. Boiling point, when barometer is 29.92 in., is 212 degrees ; boiling point at 27.74 in. is 208 degrees. In a vacuum water will boil at 67 degrees.

A cubic foot of pure water is generally taken at 62½ pounds for convenience in calculation, in freezing it expands .08553 its volume, or about one cubic foot increase for every 21½.

One pound pressure per square inch equals a height of 2.31 feet or nearly 27¾ inches.

FREEZING WATER INTO ICE.

One cubic foot of ice weighs 57½ pounds at 32 degrees. One cubic foot of water frozen into ice at 32 degrees makes 1.08553 cubic feet, the expansion in freezing being 8½ per cent.

EXAMINATION OF WATER.

Particles suspended in the water may be detected by filling a tall glass cylinder and placing same on a clean piece of white paper and looking down through the glass. All water is known as *hard* or *soft* ; and, in many cases, hard water may be made soft, and the air and gases be expelled, by boiling, in which case it is called *temporary* or removable *hardness*. If unaffected by boiling, it is called *permanent hardness*, and nothing short of distillation will remove the cause. The hardness of water is given in degrees. At 5 degrees it is soft, at 8 degrees it is moderately hard, and at 16 degrees it is very hard. The quality of hardness is particularly noticeable when soap is used to form a lather, and the amount of soap required determines degree of hardness. Hard water may be safely stated as less wholesome than soft water.

SIMPLE RULES FOR ASCERTAINING THE QUALITY OF SO-CALLED MINERAL WATER.

Water turning *blue litmus paper red* before boiling, which after boiling will not do so; and if the blue color can be restored by warming, *then it is carbonated* (containing carbonic acid).

If it has a sickening odor, giving a black precipitate with acetate of lead, *it is sulphurous* (containing sulphuretted hydrogen).

If it gives a blue precipitate with yellow or red prussiate of potash by adding a few drops of hydrochloric acid, *it is chalybeate* (carbonate of iron).

If it restores blue color to litmus paper after boiling *it is alkaline.*

If it has none of the above properties in a marked degree and leaves a large residue after boiling, *it is saline water* (containing salts).

TESTING BY RE-AGENTS.

If water becomes turbid or opaque by using the following re-agents it is not pure:

With *baryta water,* indicating carbonic acid.

With *chloride of barium* indicates sulphate.

With *nitrate of silver* indicates chloride.

With *oxalate of ammonia* indicates lime salts.

With *sulphide of hydrogen,* slightly acid, indicates presence of antimony, arsenic, tin, copper, gold, platinum, mercury, silver, lead, bismuth and cadmium.

With *sulphide of ammonia,* alkaloid by ammonia, indicates nickel, cobalt, manganese, iron, zinc, alumina and chromium.

With *chloride of mercury* or *gold and sulphate of zinc* indicates organic matter.

ALL WATER NOT WHOLESOME.

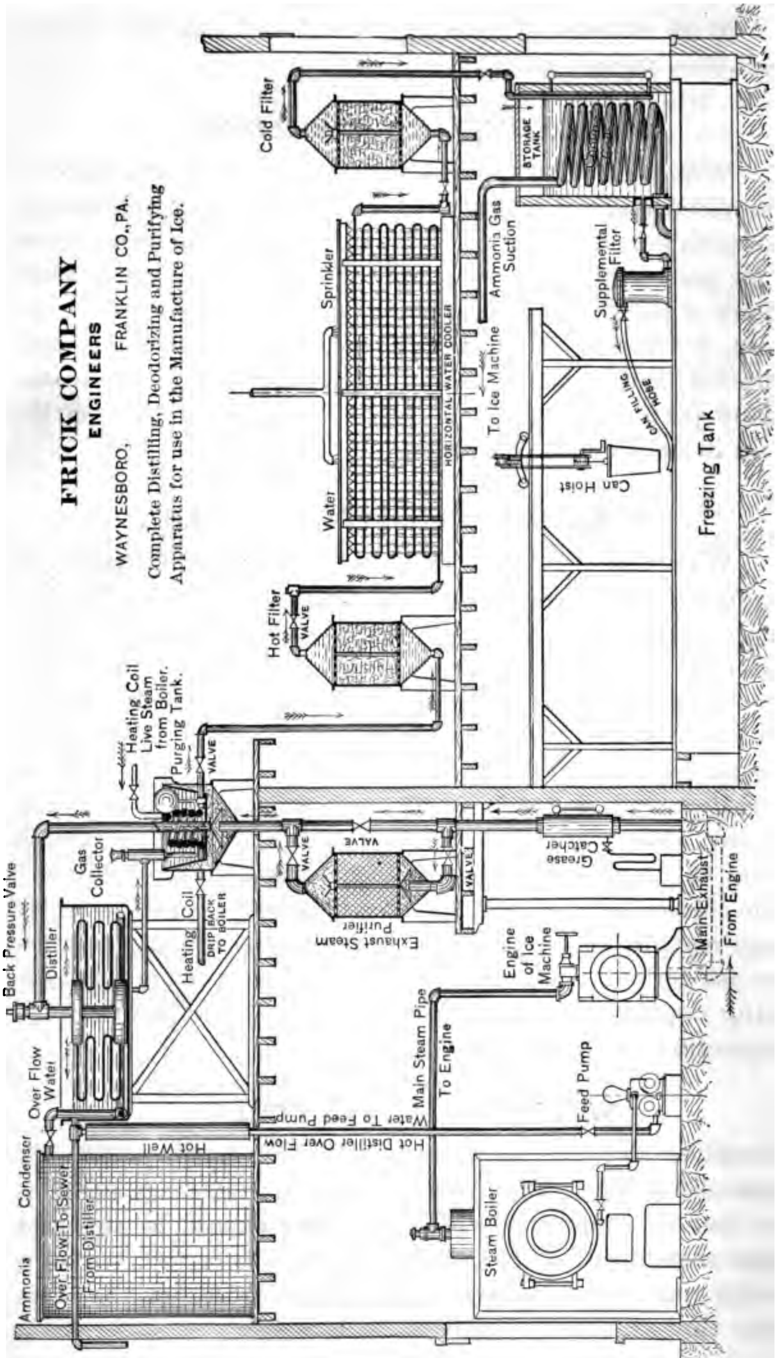
Water may be found that will pass the tests above described and yet be unfit for use, or, as commonly called, not potable. Distillation is the only method known to produce pure water, and we supply with all of our ice-making plants a perfect and complete set of apparatus for the purpose, by which all deleterious acids, gases, organic and mineral, and disease germs are eliminated and the water made perfectly hygienic. The solid and organic matter held in suspense may be removed by filtering.

CONDENSING WATER FOR MACHINERY.

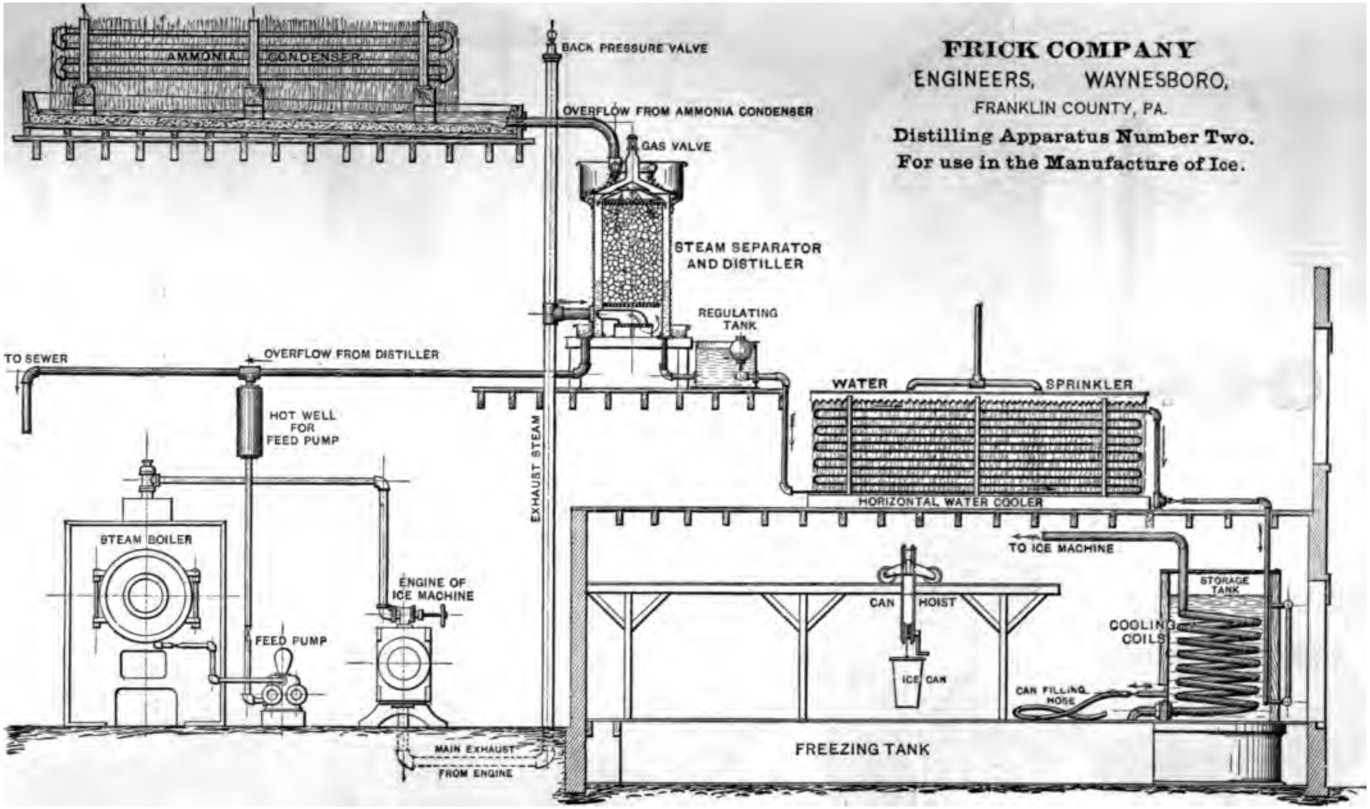
Water for use in the ammonia condensing apparatus is preferred when taken from spring or deep wells, for the reason that water from below the surface is much colder than surface water, hence much less required; the difference of temperature in surface water between midsummer and midwinter sometimes being as high as 60 degrees. Water from considerable depths is almost constant in temperature, and is generally from 50 to 56 degrees the year round, while water from rivers, ponds and streams ranges from 32 degrees in winter to 95 degrees in midsummer. The colder the water used in the condenser the less power it requires to drive the machinery. For refrigerating machines we ask for an allowance of about 1½ gallons per ton refrigerating capacity, and on ice plants 3½ to 4 gallons per ton, depending on temperature.

WATER FOR FEEDING BOILERS

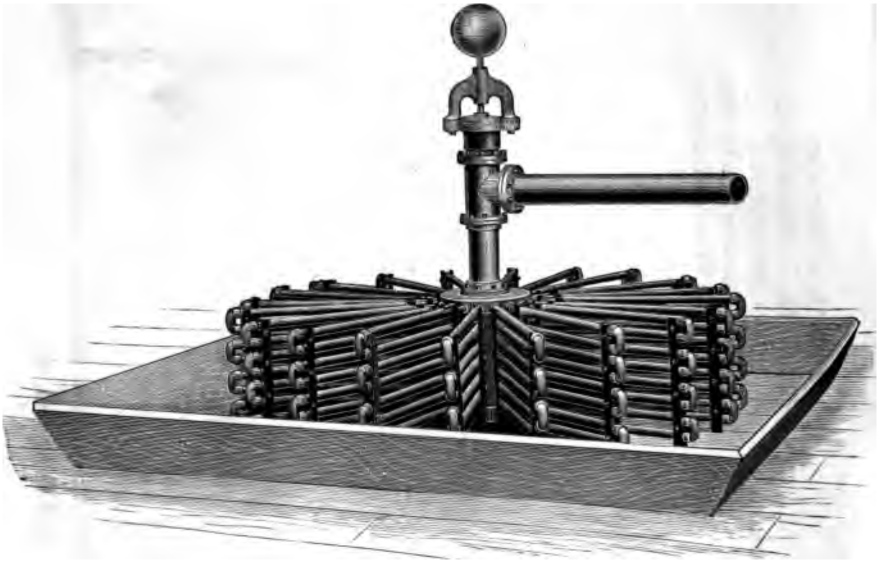
should be soft and deposit no sediment in the boiler. It quite often occurs that water from deep wells is not suitable for feeding boilers, in which case they should be supplied from some other source, or if impossible to do this, suitable water purifier and filtering system adopted, on the principle that an ounce of prevention is worth a pound of cure.



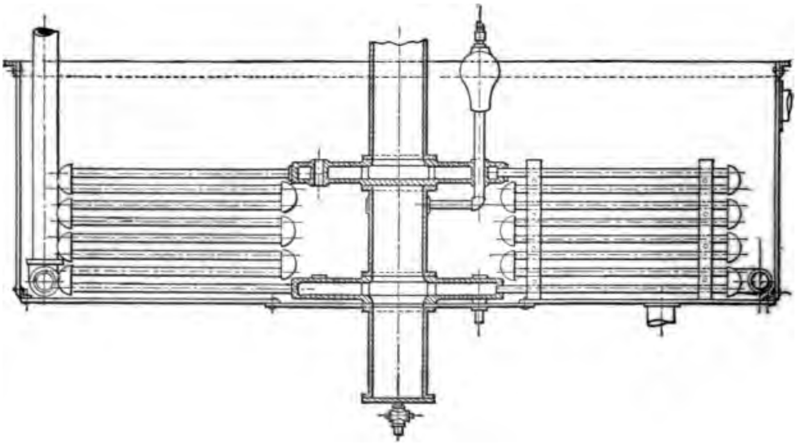
DISTILLING SYSTEM No. 1.



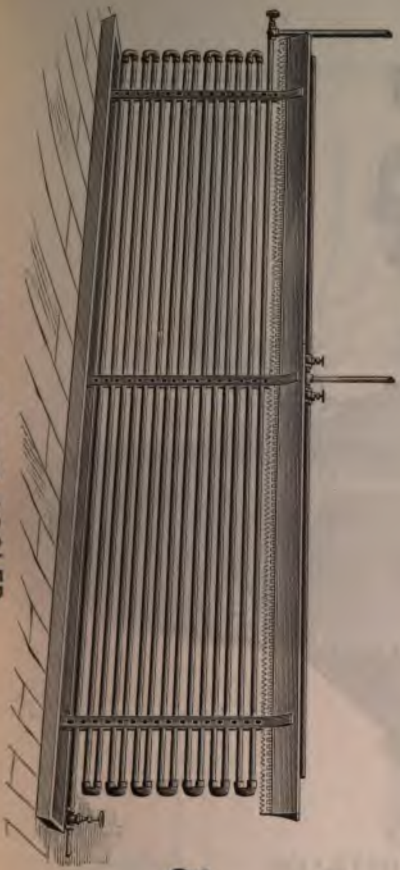
FRICK COMPANY DISTILLING SYSTEM NO. 2.



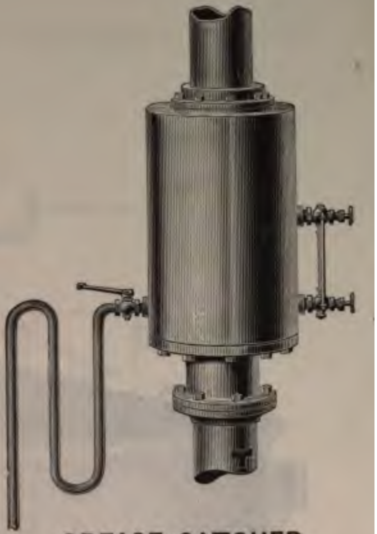
OPEN SURFACE DISTILLER.



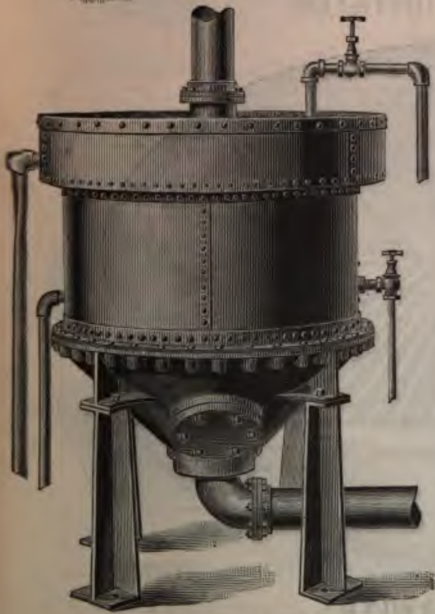
SUBMERGED DISTILLER.

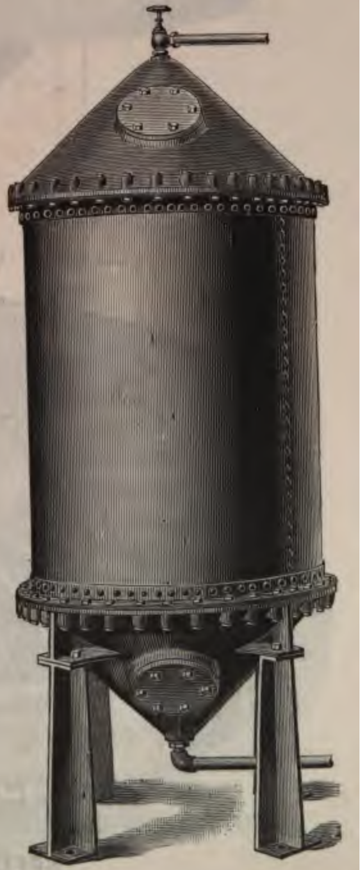


DISTILL WATER COOLER.

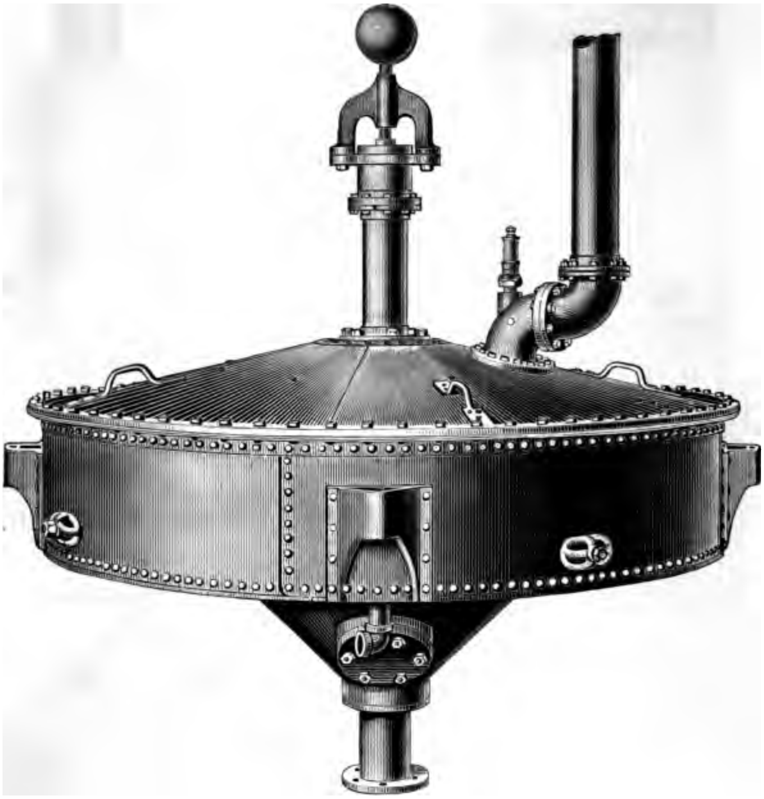


GREASE CATCHER.

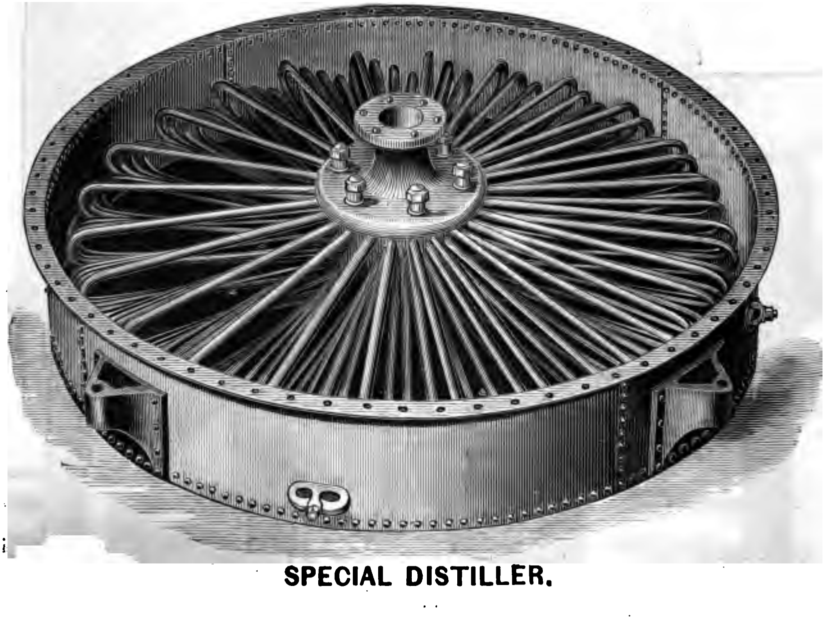




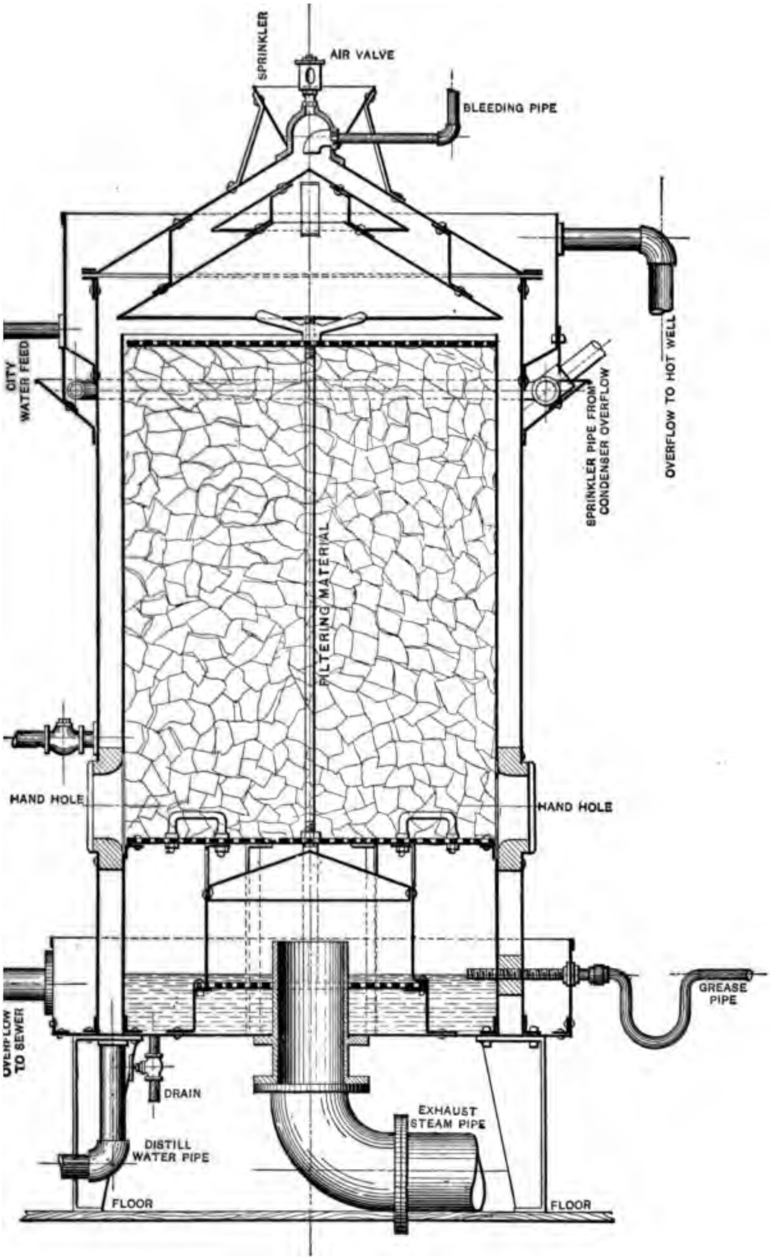
PURGING TANK AND FILTER.



SALT WATER DISTILLER.



SPECIAL DISTILLER.



PATENT-DISTILL WATER CONDENSER, SEPARATOR AND PURIFIER.

DISTILLING AND PURIFYING WATER.

MAKING DISTILLED WATER.

Exhaust steam from the engine is generally used to supply the distilled water for filling the ice moulds. The reason for this is, that it is economy to pass the steam through the engine first before distilling, as by this method at least 60 per cent of the fuel is saved that would be required if steam was taken direct from the boiler for distilling, in addition to requirements of engine; in other words, to use a common phrase, we "take the power out of the steam first," and hence run the engine without costing anything for steam. Our improved system and apparatus thoroughly separates the oil and impurities from the exhaust steam, and permits the use of any oil that is suitable for lubricating the valves and piston of the engine, as with this apparatus the oil is so completely eliminated from the steam that the ice is not affected. In our larger plants the exhaust steam from the engine is not sufficient to make up the required quantity of distilled water; the deficiency has to be made up of fresh water, which is either boiled, distilled, or drawn direct from boiler, undergoing a purifying and cleansing process before it is used in the cans. We guarantee a clear and transparent ice, free from taste or smell. The distilling and purifying apparatus consists of the following:

EXHAUST STEAM OIL SEPARATOR

which is shown upon page 111. This is a very ingenious and efficient device for the purpose. It is located in the exhaust pipe of the engine, the steam passing through it, the oil being separated, collected and rejected.

EXHAUST STEAM PURIFIER.

Engraving pages 181 and 183 is called a steam filter, or purifier, and removes all impurities carried mechanically along with the current, besides acting upon the steam beneficially in other ways.

AUTOMATIC BACK PRESSURE VALVE,

shown in page 178, is placed on the exhaust pipe. It only acts when steam is not being used in the distiller, in which case this valve opens, allowing steam to escape freely into the atmosphere.

DISTILLER OR STEAM CONDENSER

is shown upon pages 180 and 183. These are the very best arrangements ever introduced for this purpose; the pipe condenser can be used as an open air or atmospheric distiller with sprinkling apparatus, or as we furnish it, inclosed in a tank and submerged. The overflow water from ammonia condenser is utilized on both for condensing the exhaust steam.

GAS AND AIR COLLECTOR.

As water contains air and other gases dissolved in considerable proportion, which are separated in the steam boiler, and, if not rejected at a certain stage in the process, will pass into the ice, making it opaque, our plants are provided with an approved gas collector and ejector for the elimination of all air and gas.

PURGING TANK.

One office of this apparatus is to act the part of a scavenger, by vigorously boiling the water and throwing to the surface certain lighter impurities, which are disposed of by passing over the skimmer, shown on page 178.

FILTER.

From the skim tank the hot distilled water passes through a special filter charged with material remarkable for its decolorizing, sweetening, deodorizing, and generally beneficial action upon the water, and removal of subtile organic matter which may pass over with the distillate.

DISTILLED WATER COOLER.

The water is now cooled in an apparatus shown on page 181, by flowing cold water over the outer surface of the cooling pipes ; thence the distilled water passes to the

STORAGE TANK

shown on page 178, which is provided with a glass water gauge and means of thorough cleansing, a gas circulating pipe coil for reducing the water to as near as possible the freezing temperature, prior to use in the moulds. We also make a special combined storage tank with secondary filter and cooling jacket.

SUPPLEMENTAL FILTER,

filled with special filtering materials, shown on page 181, is used after the water leaves the storage tank, as a final treatment before filling the cans.

CAN-FILLING DEVICE.

An ingenious device for filling the moulds, with hose and automatic tube, is provided.

WATER FILTER.

In cases of extremely bad water, a special pure water filter is provided to filter all water used in the steam boilers.

THE ENTIRE DISTILLING APPARATUS

is made of heavy galvanized iron, riveted, caulked and soldered, and will last during the lifetime of its owner, and means are lavishly provided for purging and giving convenient access to each part of the apparatus for cleansing and examination. See pages 178 to 183.

IMPORTANT.—*The distilling apparatus must be kept clean and sweet.*

MODIFICATIONS AND ADDITIONS TO THE DISTILLING APPARATUS

are made to suit the changing conditions and quality of water used, as found necessary after an analysis of the water of the particular locality.

WATER-POWER ICE PLANT.

Where water power can be had, our machinery is well adapted, and for this purpose we use the "*Smith Patent Plate System*," the water being subjected to a thorough system of filtration, no steam being required.

CHAPTER XI.

A NEW METHOD OF MAKING ICE CALLED PLATE ICE (SMITH SYSTEM).

CAKES OF ICE MADE 16 FT. LONG, 8 FT. WIDE, 10 TO 16 INCHES THICK, CLEAR AS A SHEET OF FRENCH PLATE GLASS.

ILLUSTRATED WITH PHOTOGRAPHS AND PLANS OF FACTORIES.

DESCRIPTION OF THE SYSTEM.

INSTRUCTIONS FOR OPERATING.

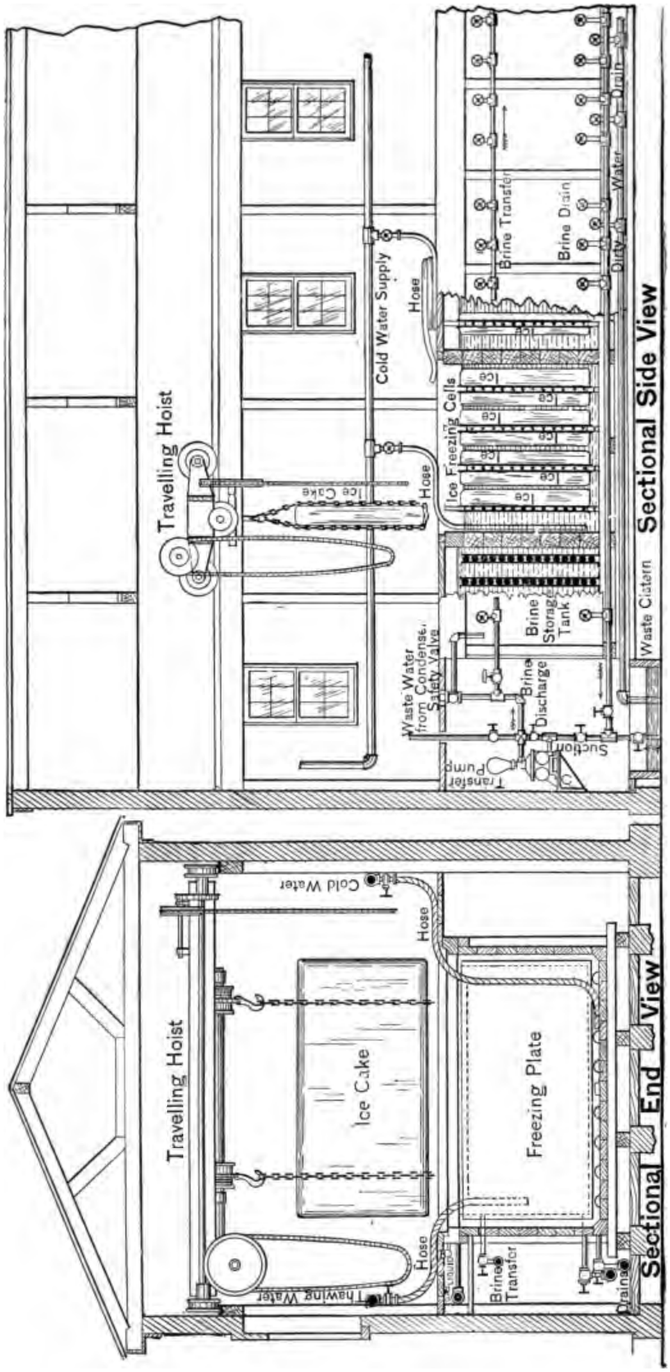
COMPLETE SPECIFICATIONS.

REFERENCES AND TESTIMONIALS.

THE LARGEST ICE FACTORY IN THE WORLD ON THIS SYSTEM.

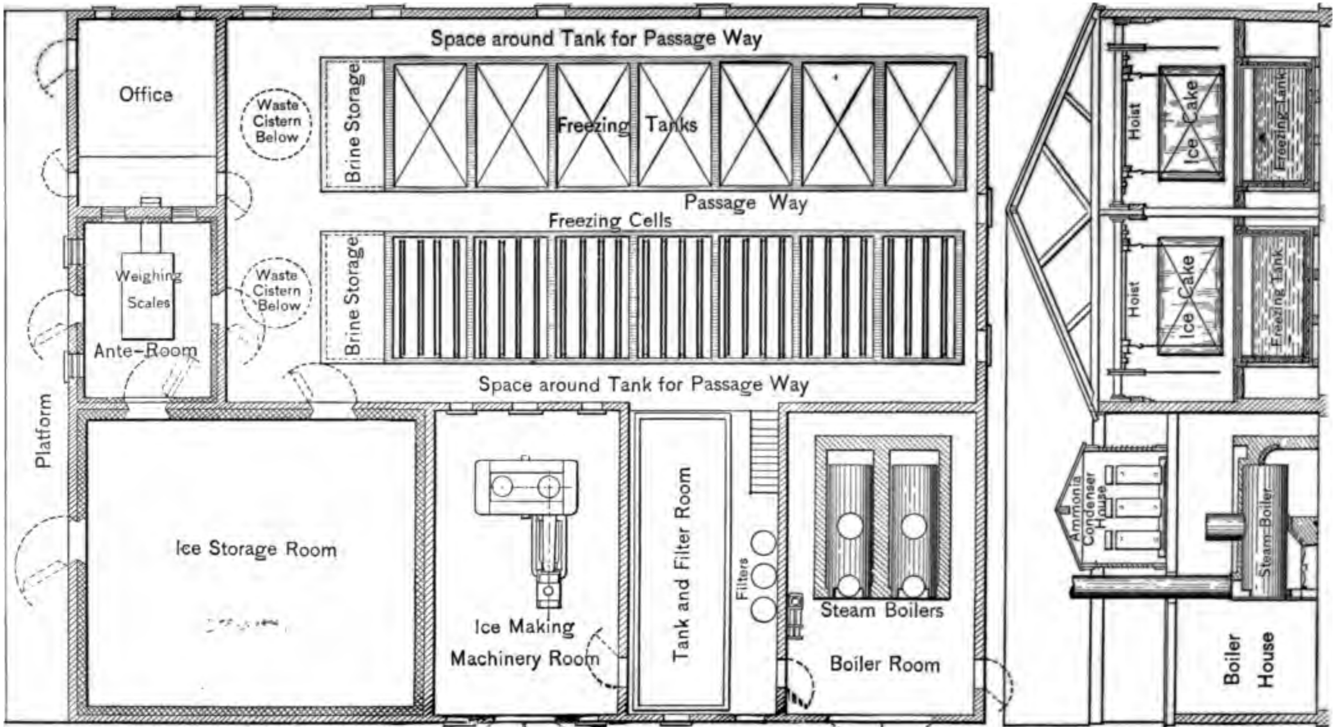
AN EXPERT CANNOT TELL PLATE ICE FROM THE BEST NORTHERN LAKE, KENNEBEC, OR NATURAL ICE FROM ANY SOURCE WHATEVER—IT IS SOLD FOR SUCH.

SMITH ICE TANK.



FRICK COMPANY
ENGINEERS WAYNESBORO
FRANKLIN CO., PA.
50 TON SMITH PLATE SYSTEM FACTORY

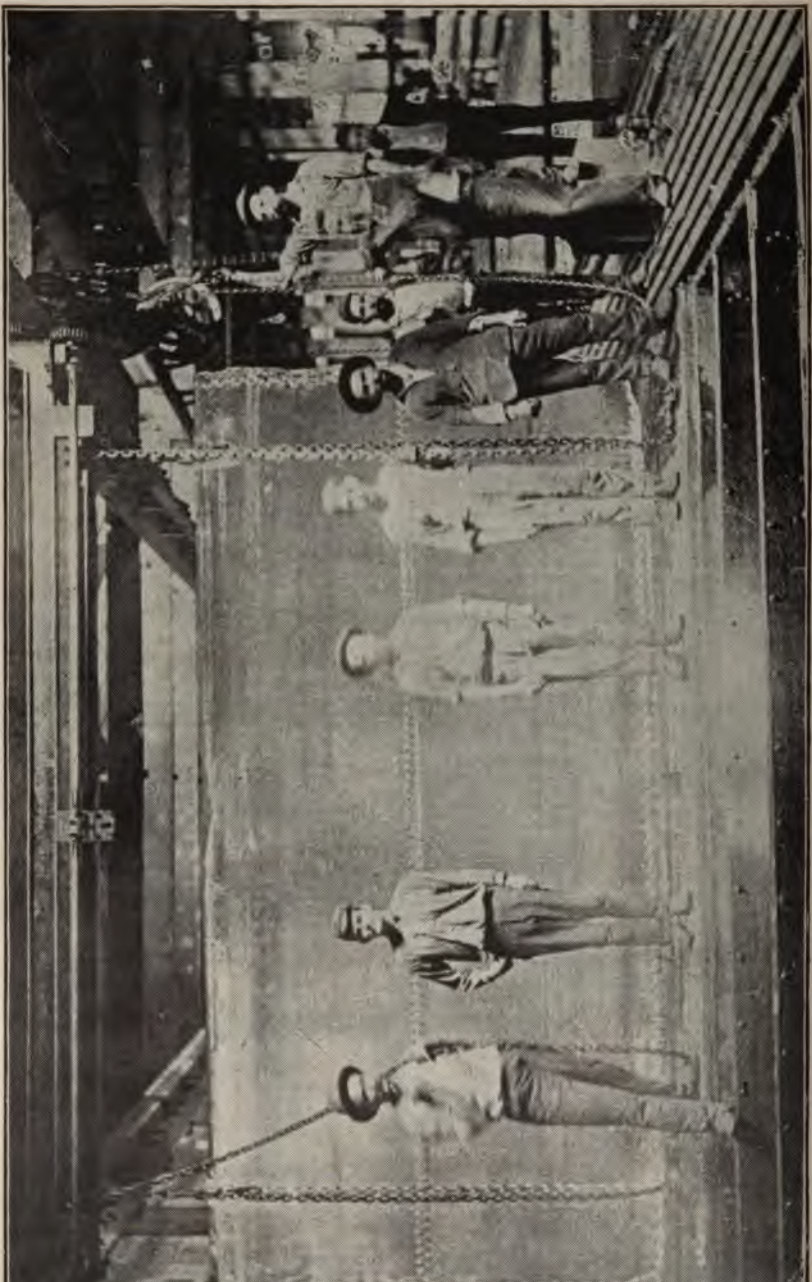
SMITH ICE FACTORY PLAN.



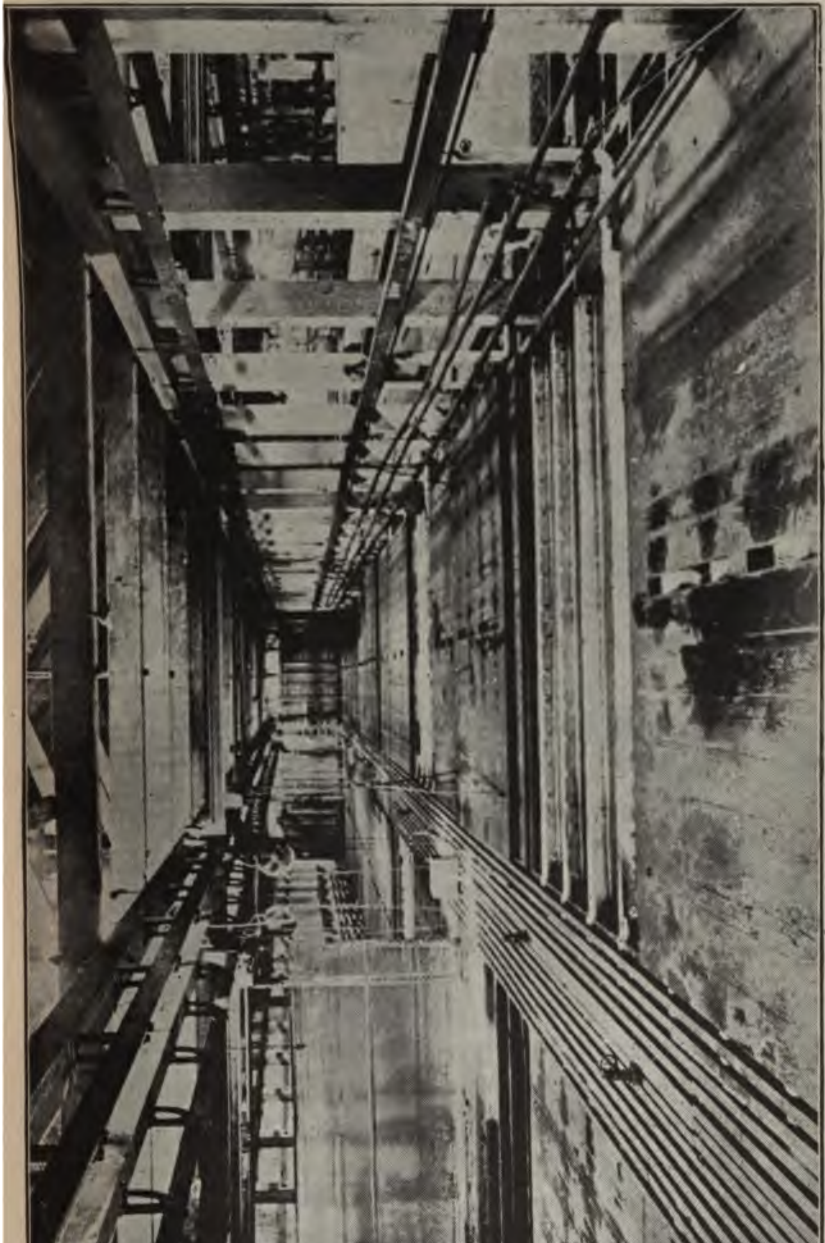
40 TON SMITH PLATE SYSTEM
ICE FACTORY

Plan View

FRICK COMPANY
ENGINEERS WAYNESBORO PA.



100 TON SMITH SYSTEM FACTORY, NEW ORLEANS, LA. CAKE OF ICE 16 FT. LONG, 8 FT. WIDE, 14 INCHES THICK.

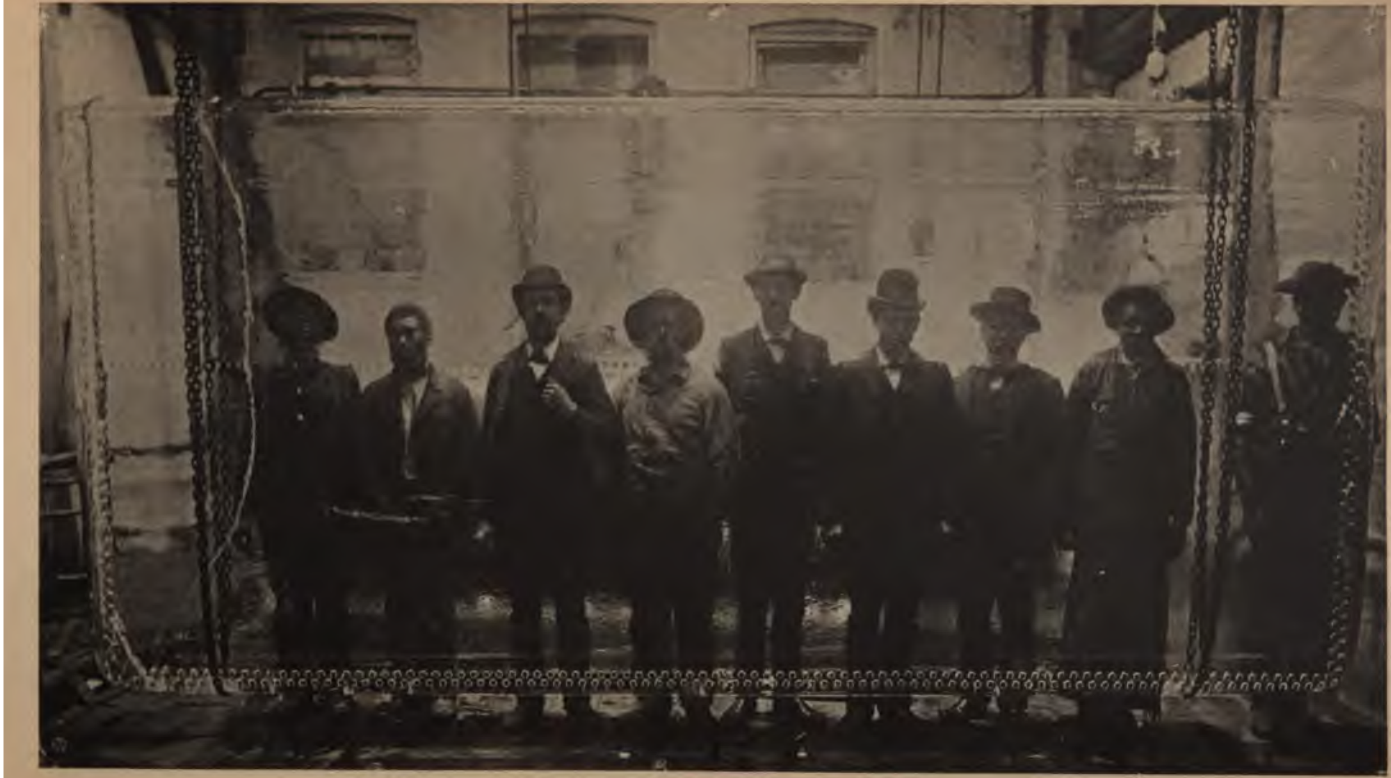


INTERIOR VIEW OF ONE-HALF OF THE LARGEST SMITH SYSTEM ICE FACTORY IN THE UNITED STATES, NEW ORLEANS, LA.

THE SMITH PATENT PLATE SYSTEM FOR MAKING SANITARY ICE.

Of which we have the exclusive control, is especially adapted where water power is obtainable, as no steam or distilling apparatus is required to make transparent ice, and hence no steam boiler or engine is needed. Ordinary drinking or potable water may be taken from any source, such as a river, lake or well, being subject to thorough filtering, and special treatment, if required, in special filters, and then allowed to remain in a cold-storage settling tank until drawn off into the ice-freezing compartments. Owing to the peculiar system of freezing, the cake of ice may be of a large size, the standard cake being 8 *feet wide,* 16 *feet long, and* 12 *to* 16 *inches thick.* Photos are shown of ice cakes made from Mississippi River water in our 100-ton Smith factory in New Orleans, La. See page 192.

All of the impurities not taken up by the filters are forced out of the water in process of freezing, and deposited in the bottom of the compartments, from which, after each freezing, the precipitate is run into the sewer and the tank cleansed, if required, by washing thoroughly preparatory to a fresh charge. The result is a fine transparent cake of ice of brilliant appearance, with a grain and texture similar to the best Kennebec ice, and far surpassing the same in solidity, coldness and transparency. The *plate ice can be split into convenient blocks*, in the same way as natural ice, and in this particular differs from the mould ice, which is apt to shiver into fragments, unless great care is taken.



Owensboro Factory Plate Ice, 16 ft. x 8 ft. x 12 in AS CLEAR AS A PLATE OF FRENCH GLASS.

NOTE.—These men are standing BEHIND the Ice.

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ASTOR, LENOX AND
TILDEN FOUNDATIONS

METHOD OF CUTTING UP AND HANDLING PLATE ICE.

In the larger plants we furnish steam gang saws with suitable carriages, the large cake of ice being partly cut by the saws and easily split by spades into required blocks, having clean square corners. The saws can be arranged to make any convenient size block with little waste.

An ice factory plan on the plate system is shown upon pages 190 and 191, and does not materially differ in other details than freezing system from ice factory on the mould plan. For lifting cakes in large plants an automatic steam hoist is used.

PHOTOGRAPHS OF PLATE CAKES.

The size of cakes shown in photograph, page 192, is 16 feet long, 8 feet wide, 14 inches thick, and weigh over three tons, and were taken at the Consumers Ice Co., at New Orleans, La., the only ice factory in the world at present making 100 tons of ice per day regularly and disposing of the products. Another photograph facing page 194 is taken from our plant in Owensboro, Kentucky.

PLATE SYSTEM TANK.

The engravings pages 192–194 show the method of forming the cake, and will be readily understood by inspection. It takes from 8 to 12 days to form a cake of ice by this system, depending upon the thickness of ice desired and purity of the water used.

HOISTING AND HANDLING PLATE ICE.

Geared travelling cranes, either steam power or hand, are furnished and handle the ice with surprising ease, and convenient means are provided to hoist the cake from the tank with certainty and safety.

ADVANTAGES OF THE PLATE SYSTEM

have been in part enumerated, and can be seen at a glance by those who have had experience in ice-making or have carefully read the chapter on ice-making.

PATENTS.

This system was patented by Mr. David Smith, deceased, and we now have the exclusive license for all patents granted on his process and apparatus, and are prepared to furnish plants on this system from 5 to 1000 tons daily capacity.

INSTRUCTIONS FOR OPERATING THE SMITH PLATE SYSTEM FOR MAKING ICE.

Referring to actual practice, it is found that to make ice 10 inches thick requires from 9 to 10 days at the slowest rate, and about 6 days at the fastest rate, under favorable conditions, and thicker ice is about proportional to the square of its thickness.

THE APPARATUS IN A SMITH PLATE SYSTEM CONSISTS—

First. Of a compartment having one or more brine cells made up of steel plates, each containing ammonia-evaporating coils. The cells are placed in the compartments at such distances apart as to allow the ice to form therein without freezing together, the ice-building process going on until the cakes stand within about 1½ inches of each other.

Second. A large tank, called the cold water tank, in which the water used in the compartments is stored and allowed to settle, being "forecooled," by direct expansion pipe coils or the return suction pipe to pump, to as near as possible to the freezing point before being drawn into the freezing tank compartments.

Third. A cistern located at a lower level than the freezing tank proper, into which the impure water left after freezing may be drawn if necessary.

Fourth. The transmission pump used for emptying the cells of brine and storing it in the brine tank (generally located at the end of main freezing tank).

Fifth. The tank system of piping for draining the compartments, transferring the brine, etc.

Sixth. The hoisting arrangement for handling the cakes of ice.

Seventh. The supply system of piping leading from the cold-storage tank and hydrant or city water, each provided with suitable hose for filling and washing out the tanks and cells.

Eighth. A brine storage tank, provided with evaporating coils for cooling and storing brine emptied from cells.

Ninth. The cutting table, operated by hand or steam power according to size of plant.

SMITH PLATE SYSTEM.

METHOD OF OPERATION.

Assuming that the ice-making machine and apparatus is in complete working order, the first thing is to thoroughly cleanse the tanks. Next fill the compartments in regular order within about 9 inches of the top, with water drawn from the pure water filters.

Next fill the freezing cells with brine, open the liquid ammonia expansion valves, regulating exactly the amount of ammonia fed to each cell. The expansion valve should be watched and adjusted from time to time, and by them the rate of freezing and thickness on plate surface is easily regulated.

In starting up a fresh compartment, the water, brine and tanks are necessarily warm and contain considerable heat, for which reason they will at first evaporate a larger quantity of ammonia in the coils than after the water has been cooled to the freezing point and the ice formation begins. The coils then having less capacity for evaporating, require a reduced feed to prevent heavy frosting on the suction side.

The best method of starting the plant, assuming the machinery to be in complete running order, is to fill No. 1

compartment with water, then fill the cells with brine, open the expansion valves, and proceed with the freezing, repeating the filling process with each successive compartment in the tank at regular intervals, until all are filled. The first tank in this case to be frozen to thickness required would be number one.

To ascertain when the ice is of proper thickness, there are oblong holes left in the cover, through which a gauge stick can be inserted between the cakes of ice. When it is found that the cakes have formed within about 4 inches of each other, shut off the ammonia expansion valves (leave the suction valves open). The process of freezing will still continue after the ammonia is shut off, and the ice building goes on for a period of 10 to 12 hours thereafter, adding from three-quarters inch to one inch additional thickness. It is economy to thus utilize to the fullest extent all the cold stored in the brine, the plates, and the ice itself, by allowing the cake to stand after the expansion valves are shut.

To take the ice from the tank, the first thing to do is to withdraw the brine from the cells by means of the brine pump, transferring it to the brine store tank.

Next, allow as much of the residual water in the compartment after freezing as may be turbid to run out of the tank into the cistern, and note that only a portion (representing the settlings at the bottom of the tank) may be thus wasted. When the turbid water has been run off and clear water begins to flow, shut off the drain. We find in practice that some waters need not be drawn off at all.

Next, with the filling hose from the cold water main leading from store tank, fill the compartment to the original height.

Next fill the brine coils with water from the thawing hydrant main. 50 to 60 degrees is about the right temperature for the thawing water. If the water is very much above the 60 degrees, it is rather too warm for thawing purposes, and the cake will be apt to shiver or crack, from the sudden change in temperature. Allow thawing water to remain in the cells for a period ranging from 5 to 6 hours.

It may be necessary at times to draw the first charge of thawing water from the cells and repeat, for the reason that it may become cooled to such an extent that it is of no further use in loosening the cakes. By inserting a thermometer in the cell, the temperature of the thawing water can be obtained, and if found to be as low as 36 degrees and the ice still adheres firmly to the plates, it is best to run this water into the cistern, and use another supply of thawing water. At the end of 6 hours, the first cake to be taken out is the one that is at the bulkhead nearest cutting table. With the chisel bars inserted between the plate and cake, in two or three places, gently pry the cake from the plate. Right here we would say that it is not necessary that the cake of ice should be melted sufficiently to allow it to float away from the plate without resort to the chisel bar. Upon the cake being loosened, it will naturally rise in the tank. The water in the compartment will correspondingly lower.

The ice is hoisted from the tank by means of two chain slings or special tongs. In using the sling, take a loop of copper wire, and when the cake has floated off, pass the loop under the cake and fasten to chain sling, drawing up the loop, the chain is passed around the cake. Make as close a hitch as possible, by hooking into the large links at the ring end of the chain, lifting the cake from the tank by the crane, and carrying it to the cutting table.

As the water lowers when each cake is raised from the tank, it is better to run the cold water in, that the original level may be maintained. Insert the hose into vacant space.

At the cutting table mark the ice in blocks by the template frame ; cut with the hand plows or steam saws, say 2 inches deep ; then separate with splitting bar.

Repeat the process just described with each cake in the frozen compartment, allowing the fresh water, during unloading of the tank, to run in fast enough to maintain water at the original level.

After stripping a compartment, run the thawing water out of the cells and fill again with cold brine, by opening the pipe connecting the plates with the brine store tank, using transfer pump for this purpose.

After recharging compartment, put on the covers, open expansion valves, and proceed with freezing as before.

The office of the transfer pump is principally to empty and recharge cells with brine. The thawing water used in the cells can be run into the cistern by gravity (the cells emptying themselves). The waste cistern should be located in all cases below the tank.

The transfer pump is also used for drawing the water from the waste cistern, for use on the ammonia condenser, thus fully utilizing the cold water drained from the tank and plates.

It is a good plan, after a number of freezings, to entirely empty the compartments, in their turn, and thoroughly wash and scrub the tank and plates, as more or less sediment may collect thereon if water is not the best. In cleaning the compartment the transfer pump may be employed to pump the water from this compartment to a spare compartment, or the water can be pumped back into the cold-storage tank ; the supply in the cold-storage tank, of course, having been previously regulated to give room for a whole compartment of water.

The directions given above will, in a general way, give the reader an idea as to the methods of operating the Smith Plate System, and this, supplemented by a little practice, will be sufficient to enable any intelligent man to operate the plant satisfactorily.

The accompanying drawings will assist in illustrating and making plain the above description, and to demonstrate that our plate system is effective, economical, and fully developed, notwithstanding that competitors who have had no experience with our perfected plate machinery say to the contrary—there are some tricks they have yet to learn in this connection.

SMITH SYSTEM PLANT SPECIFICATIONS.

WHAT WE FURNISH WITH OUR STANDARD PLANT.

MACHINE SYSTEM.

One or more pair of single-acting gas compressors, as required, complete with Corliss or cut-off steam engine, necessary ammonia condenser, oil separator, traps, and all connections complete.

FREEZING-TANK SYSTEM.

Are made in several compartments, each compartment to be fitted with several sections, with freezing plates having hardwood frames or channel frames.

Each plate cell to contain suitable ammonia evaporating coils fitted with Stands, Braces, Valves, and Headers complete.

Cake of ice to be about 16 ft. long, 8 ft. wide, 10 to 16 in. thick, as agreed, and is estimated to weigh respectively from 5000 to 8000 pounds, or 500 pounds per each inch thickness.

We furnish hand or steam travelling hoisting cranes, of 4 tons capacity each; purchasers are required to furnish the woodwork for same, erected in place as per our plans.

We furnish suitable return suction, or direct ammonia coils, for "forecooling" the ice-making water and keeping brine at needed temperature in storage tank.

We furnish suitable pumps for transferring brine and water to and from tanks and plate cells.

We furnish PURE WATER FILTERS of adequate gallons capacity each, with pipe connections for same. Filters of an improved construction, and capable of supplying with ease all water required each 24 hours.

STEAM BOILERS.

When furnished by us to be Horizontal Tubular style, fitted with full flush fronts, fixtures and mountings, and everything necessary for setting boiler, except mason work and material, needed feet of smoke stack, with damper, guy rods and hood.

Boilers furnished by us with ice plant are guaranteed to be of ample capacity to furnish steam to operate ice-making machine and all pumps.

Needed steam feed pump and first-class feed heater with connections—main steam and exhaust pipe for engine.

ERECTION OF MACHINERY.

We furnish one competent erecting engineer to superintend the erection ; purchaser to furnish one engineer to assist in erecting and receive instructions in putting together and running the machinery.

Complete plans furnished for foundations (and when required, of building to accommodate machinery).

Foundation bolts for machine, with anchor washers and templates for setting.

GUARANTEES.

We guarantee the machinery furnished by us to make tons named of transparent merchantable ice daily in mid-summer, when run continuously and properly managed.

PURCHASER WILL BE REQUIRED TO FURNISH THE FOLLOWING:

To deliver inside building, adequate gallons water daily, suitable for making ice ; said waters being subjected by us to thorough filtering, as is the usual practice in the Smith patent plate ice-making system ; to supply and deliver at the various parts of the apparatus, water suitable for condensing and thawing as required, all necessary labor for hoisting, moving and placing machinery in proper position ; to properly insulate and furnish wood curbing for tanks ; furnish salt to make brine solution, and ammonia for charging machinery; also to pay all freight and other transportation expenses, and to furnish the following wood tanks according to our plans and drawing:

One cold storage tank of wood of given dimensions.

Freezing tanks of given dimensions, made of best pine wood, sides four inches, bulkheads 10 x 10 inches, each tank to have several compartments 17 feet wide, 9 feet high, all fitted up in a workmanlike manner, and made perfectly tight by caulking and pitching.

One brine storage tank of wood of given dimensions; also one drain water tank of wood of given dimensions. And to insulate the above tanks properly and furnish removable covers where needed, all according to our drawings and specifications.

We guarantee workmanship and materials for one year, provided no disarrangement is caused by carelessness, incompetency, or want of attention of person in charge, and if run according to our instructions.

We guarantee the Refrigerating Machine Condenser and Jackets to use not to exceed two gallons of condensing water per ton of ice per minute, at a maximum temperature of 75° Fah.

Payments. One-quarter cash with order; one-quarter cash on arrival of machinery on cars at nearest point; one-quarter cash after thirty days' test, and the balance by interest-bearing note, payable two months after termination of test, *or as may be otherwise agreed.*

A New Process for Making Ice.

THE SMITH PATENT PLATE SYSTEM.

The following Smith Patent Plate System plants have been erected:

Consumers' Ice Company, New Orleans, La.	**100 tons**
Smith Transparent Ice Mfg. Co., Washington, D. C.	**50 tons**
Raleigh Ice Co., Raleigh, N. C.	**15 tons**
Danville Ice Co., Danville, Va.	**15 tons**
Spartanburg Ice Co., Spartanburg, S. C.	**6 tons**
Smith Ice Plant, Richmond, Va.	**10 tons**
Smith Ice Factory, Caracas, Ven., S. A.	**10 tons**
Honolulu Ice Co., Honolulu, Sandwich Islands	**10 tons**
Owensboro Ice Mfg. and Cold Storage Co., Owensboro, Ky.	**15 tons**

Other plants in process of erection.

Testimonial from 100-Ton Smith Plate System, the Largest Ice Factory in the World, using our 100-Ton Eclipse Ice Machine.

CONSUMERS' ICE COMPANY.

New Orleans, La., *Sept.* 16, 1888.

The Frick Company, Waynesboro, Pa.

Dear Sirs:—I take pleasure in testifying to the very satisfactory results we have had from the use of the "Smith" system of making ice. I regard the quality of the ice superior in density and clearness to any I have ever seen, natural or manufactured, and its freedom from the disagreeable taste so common in ice made in moulds is of immense advantage. Though of great size, the blocks are handled with economy and small expense.

Yours truly,
U. S. WALLACE,
President Consumers' Ice Co.

30-Ton Smith Plant in Georgetown, D. C., using Water from the Potomac River.

West Washington, D. C., *Sept.* 23, 1888.

Frick Company, Waynesboro, Pa.

Gentlemen:—The Smith Transparent Ice Manufacturing Company, of Washington, D. C., has been in full and constant operation since 1881. To prove the excellency of your manufactured ice, I copy a few extracts from testimonials given us in June, 1887:—

Here is what Consumers of the Smith Ice say of it.

We have been using the Transparent Ice Co.'s ice for the last five years. It has always given perfect satisfaction, and we consider it as durable as any ice we ever used. Yours truly,

C. W. SPOFFORD,
Proprietor of the Riggs House.

We have been using the transparent manufactured ice about five years and know it to be of good quality, and more lasting than the natural ice.

JNO. R. LANGLEY & BRO.,
Proprietors of the Morgan House.

I have been using the Smith Transparent Ice Co.'s ice in the house and it has given perfect satisfaction, both in drinking water and in refrigeration. It lasts longer and leaves no sediment in the water, as ordinary ice is apt to do.

HORACE M. CAKE,
Proprietor of Hotel Richmond.

The ice which you have been supplying to us for the last three years has given entire satisfaction. We find it in every respect equal to the best.

WEAVER, KENGLA & CO.,
Soap Manufacturers.

Our company (Washington & Georgetown R. R. Co.) has been using your ice several years and expect to continue to do so as long as you continue to give the satisfaction you have done heretofore.

C. M. COONES,
Secretary and Treasurer.

In the light of experience and trial of this ice for the last five years for cooling water, refrigerating, and for ice at the bedside of the sick, I have found it to be finer, last longer, and in every particular to be more satisfactory than river ice.

H. E. KALUSOWKI,
Pharmacist.

It has given me thorough satisfaction, and I consider it as good and fine as any that I have used from other companies.

GEO. CROPLY,
Druggist.

I can recommend it as superior to the natural ice in every particular.

RULAND B. BANCROFT,
Druggist.

It is useless to quote from numerous other testimonials of like character. It may seem incredible that our manufactured ice should last longer than natural ice, but the fact is due to its being newly made. Old ice has absorbed considerable caloric. The test has been repeatedly made with equal-sized cakes of the manufactured and the best Kennebec ice. At first they appear to melt away alike ; but by and by the core of the Kennebec ice drops to pieces, while the core of the manufactured ice remains perfectly sound. The longer ice is stored the less cold there is in it.

W. H. BURR,
Treas. Smith Transparent Ice Mfg. Co.

JOHN REINHARDT, *President.* J. W. REINHARDT, *Secy. and Treas.*
OWENSBORO ICE MANUFACTURING AND COLD STORAGE COMPANY,
MANUFACTURERS AND WHOLESALE AND RETAIL DEALERS IN PURE ICE.
Factory: St. Elizabeth St., bet. Main and Third.
Telephone 94.

OWENSBORO, KY., *Oct.* 21, 1889.

Messrs. FRICK COMPANY, Waynesboro, Pa.

Gentlemen :—We are pleased to state in answer to your inquiry that we are more than satisfied that we concluded on the Smith Plate System for freezing ice. We had contracted, as you know, for the Can System, but after duly considering the matter, concluded the Smith System would prove more satisfactory. The ice is far superior in density and clearness to any manufactured or natural ice, and gives perfect satisfaction to consumers. We would be pleased to show any one through our plant who is contemplating the purchase of ice machinery.

Yours very respectfully,
OWENSBORO ICE MFG. & C. S. CO.,
JNO. REINHARDT, *Prest.*

CHAPTER XII.

GENERAL INFORMATION.

SATISFACTION FOR ENGINEERS, WHO WILL ENJOY READING IT.

PROPERTIES OF AMMONIA.

TABLE OF TEMPERATURES AND PRESSURES.

TESTS FOR AMMONIA AND SPECIFIC GRAVITY.

TESTING AND CHARGING REFRIGERATING AND ICE-MAKING APPARATUS, TO TELL WHEN YOUR COMPRESSORS ARE WORKING WELL.

AIR IN THE SYSTEM.

HOW TO MAKE BRINE.

HOW TO SELECT A MACHINE TO SUIT YOUR PREMISES.

SOME INTERESTING AND USEFUL TABLES.

IRON PIPE—SATURATED STEAM.

COMPARISON OF THERMOMETER SCALES.

KIND OF OIL TO USE IN ICE MACHINES.

TO SET THE VALVES OF OUR REFRIGERATING ENGINES, ETC.

A CHAPTER ON AMMONIA.

Ammonia is composed of one part of nitrogen and three parts hydrogen. It can be obtained from the air, from sal-ammoniac, nitrogenous constituents of plants and animals by process of distillation: as a matter of fact, there are very few substances free from it.

At the present day almost all the sal-ammoniac and ammonia liquors are prepared from ammoniacal liquid, a bye-product obtained in the manufacture of coal gas. For a study of ammonia we refer you to the work of G. Lunge.

PROPERTIES OF AMMONIA.

Pure ammonia liquid is colorless, having a peculiar alkaline odor and caustic taste. It turns red litmus paper blue. Its boiling point depends on its purity, and is about $28\frac{6}{10}$ degrees below zero at atmospheric pressure. Compared with water, its weight or specific gravity at 32 degrees F. is about $\frac{5}{8}$ of water, or 0.6364. One cubic foot of liquid ammonia, weighing 39.73 pounds, one gallon weighs 5 and $\frac{3}{10}$ pounds, one pound of the liquid at 32 degrees, will occupy 21.017 cubic feet of space when evaporated at atmospheric pressure. The specific heat of ammonia gas, as determined by Regnault (capacity for heat), is 0.50836. Its latent heat of evaporation, as determined by the highest authorities, is not far from 560* thermal units at 32 degrees, at which temperature one pound of liquid, evaporated under a pressure of fifteen pounds per square inch, will occupy twenty-one cubic feet.

We have the following table from Prof. Wood, compared with Regnault's celebrated experiments, showing the pressure of ammonia gas per square inch at the given temperatures Fahrenheit.

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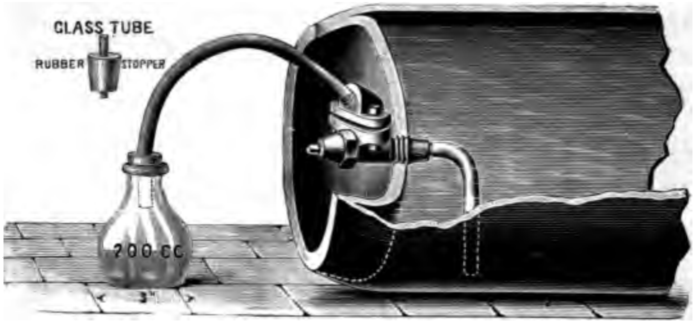
* The records of Regnault, giving exact latent heat of evaporation of ammonia, were unfortunately destroyed during the French civil war.

Pressure in Pounds per Square Inch of Ammonia Gas, Corresponding to Temperatures Fah. named. Saturated Ammonia.

TEMPERATURE.		PRESSURE, p. (From a vacuum.)		Heat of Vaporization, Thermal Units. h_e	External Heat, Thermal Units. $\frac{p. v.}{J}$	Internal Heat, Thermal Units. $p = h_e \frac{p. v.}{J}$	Volume of Vapor per lb. *cub. ft.* v	Volume of Liquid per lb. *cub. ft.* v_2	Weight of a *cub. ft.* of vapor pounds. $\frac{1}{v}$	Gauge Pressures per square inch.
Degree F. T.	Absolute T.	Lbs. per square foot.	Lbs. per sq. inch.							
— 40	420.66	1540.	10.69	579.67	48.25	531.42	24.38	.0234	.0411	0
— 35	425.66	1773.6	12.31	576.69	48.35	528.34	21.21	.0236	.0471	0
— 30	430.66	2035.8	14.13	573.69	48.85	524.84	18.67	.0237	.0535	0
— 25	435.66	2329.5	16.17	570.68	49.16	521.52	16.42	.0238	.0609	1.47
— 20	440.66	2656.4	18.45	567.67	49.44	518.23	14.48	.0240	.0690	3.75
— 15	445.66	3022.5	20.99	564.64	49.74	514.90	12.81	.0242	.0775	6.29
— 10	450.66	3428.0	23.77	561.61	50.05	511.56	11.36	.0243	.0880	9.07
— 5	455.66	3968.0	27.57	558.56	50.44	508.12	9.89	.0244	.1011	12.87
+ 0	460.66	4373.5	30.37	555.5	50.66	504.12	9.14	.0246	.1094	15.67
+ 5	465.66	4920.5	34.17	552.43	50.84	501.59	8.04	.0247	.1243	19.47
+ 10	470.66	5522.2	38.55	549.35	51.13	498.22	7.20	.0249	.1381	23.85
+ 15	475.66	6182.4	42.93	546.26	51.33	494.93	6.46	.0250	.1547	28.23
+ 20	480.66	6905.8	47.95	543.15	51.65	491.50	5.82	.0252	.1721	33.25
+ 25	485.66	7695.2	53.43	540.03	51.81	488.22	5.24	.0253	.1908	38.73
+ 30	490.66	8556.4	59.41	536.92	52.02	484.90	4.73	.0254	.2111	44.71
+ 35	495.66	9493.9	65.93	533.78	52.22	481.56	4.28	.0256	.2336	51.23
+ 40	500.66	10512.	73.00	530.63	52.42	478.21	3.88	.0257	.2577	58.30
+ 45	505.66	11616.	80.66	527.47	52.62	474.77	3.53	.0260	.2832	65.96
+ 50	510.66	12811.	88.96	524.30	52.82	471.44	3.21	.02601	.3115	74.26
+ 55	515.66	14102.	97.63	521.12	53.01	468.01	2.93	.02603	.3412	82.93
+ 60	520.66	15494.	107.60	517.93	53.21	464.76	2.67	.0265	.3745	92.90
+ 65	525.66	16994.	118.03	515.33	53.40	461.82	2.45	.0266	.4081	103.83
+ 70	530.66	18606.	129.21	511.52	53.67	457.95	2.24	.0268	.4664	114.51
+ 75	535.66	20389.	141.25	508.29	53.76	454.70	2.05	.0270	.4978	126.55
+ 80	540.66	22192.	154.11	504.66	53.96	450.75	1.89	.0272	.5291	139.41
+ 85	545.66	24172.	167.86	501.81	54.15	447.75	1.74	.0273	.5747	153.16
+ 90	550.66	26295.	182.8	498.11	54.28	443.70	1.61	.0274	.6211	168.10
+ 95	555.66	28566.	198.37	495.29	54.41	440.95	1.48	.0277	.6756	183.67
+100	560.66	30980.	215.14	491.50	54.54	437.35	1.36	.0279	.7353	200.44

A FEW TESTS FOR AMMONIA.

Ammonia liquid for use in our refrigerating machines should be pure, and we give the following simple methods for testing, for which we furnish apparatus.



TESTING FOR WATER BY EVAPORATION.

As shown by the engraving, screw into the ammonia flask a piece of bent one-quarter-inch pipe, which will allow a small bottle to be placed so as to receive the discharge from it. This test bottle should be of thin glass with wide neck, so that quarter-inch pipe can pass readily into it, and of about 200 cubic centimeters capacity. Put the wrench on the valve and tap it gently with a hammer. Fill the bottle about one-third full, and throw sample out in order to purge valve, pipe and bottle. Quickly wipe off the moisture that has accumulated on the pipe, replace the bottle and open valve gently, filling the bottle about half full. This last operation should not occupy more than one minute. Remove the bottle at once, and insert in its neck a stopper with a vent hole for the escape of the gas. A rubber stopper with a glass tube in is the best, but a rough wooden stopper, loosely put in, will answer the purpose. Procure a piece of solid iron that should weigh not less than eight or ten pounds, pour a little water on this and place the bottle on the wet place. The ammonia will at once begin to boil, and in warm weather will soon evaporate. If any residuum pour it out gently, counting the drops carefully. Eighteen drops are about equal to one cubic centimeter, and if the sample taken amounted to 100 cubic centimeters, you can readily approximate the percentage of the liquid remaining.

Care is necessary in the drawing off the sample, as a very little moisture in the bottle or in the pipe, or a brief exposure to the atmosphere, will at once affect it.

TEST FOR INFLAMMABLE GASES.

Take a pail of water, submerge the bent end of quarter-inch pipe therein, open the valve on flask slightly, and allow a small quantity of gas to flow into the water. If inflammable gases are present, they will rise in bubbles to the surface of the water, and may be proved by igniting the bubbles by means of a lighted candle or match. As water has a strong affinity for ammonia, it will be readily absorbed, while air or other gases will show only in the form of bubbles.

TEST FOR SPECIFIC GRAVITY.

The specific gravities of liquid ammonia by Beaume scale are given in table below ; by drawing off some of the liquid in the tall test tube we provide, the Beaume Hydrometer (light) may be inserted and the specific gravity read upon the scale ; if water is present the liquid will show a density proportionate to the percentage of water present.

TABLE OF SPECIFIC GRAVITIES AND PERCENTAGE OF AMMONIA (CARIUS).

Degrees Beaume.	Specific Gravity.	Percentage.	Degrees Beaume.	Specific Gravity.	Percentage.
10	1.000	0	21	.9271	19.4
11	.9929	1.8	22	.921	21.4
12	.9859	3.3	23	.915	23.4
13	.979	5.	24	.909	25.3
14	.9722	6.7	25	.9032	27.7
15	.9655	8.4	26*	.8974	30.1
16	.9589	10.	27	.8917	32.5
17	.9523	11.9	28	.886	35.2
18	.9459	13.7	29	.8805	
19	.9395	15.5	30	.875	
20	.9333	17.4			

* Called by the trade 29½ per cent.

Specific gravity of pure anhydrous ammonia is .623.

TEST FOR BOILING POINT.

By inserting the special low temperature standardized chemical thermometer into liquid drawn into the 8-oz. test jar, readings can be obtained through the side of the jar without removing the instrument. Hold the thermometer in such position that only the bulb is immersed. This test will give you the boiling point of ammonia at atmospheric pressure; and it is well to know that the state of the barometer affects the temperature of the boiling point. With the barometer at 29.92 inches, the boiling point is nearly 28$\frac{6}{10}$ degrees below zero. If the ammonia is impure, the boiling point is raised in proportion.

The above are the simplest tests commonly used to determine the quality of the ordinary article furnished by manufacturers of anhydrous ammonia for use in ice-making and refrigerating machines.

TESTING AND CHARGING THE REFRIGERATING MACHINERY.

It is important, before introducing the charge of gas into the machine system, to carefully test every part of the apparatus, and make it thoroughly tight under at least 300 pounds air pressure, which pressure may be obtained by working our ammonia compressor and allowing free air to flow into suction side of pump by opening special valves provided by us for this purpose, the entire system being thus filled with compressed air at the desired pressure. While this pressure is being maintained, a search is instituted for leaks, every pipe, joint, and square inch of surface being tediously scrutinized. One method is to cover all surfaces with a thick lather of soap, leaks showing themselves by formation of soap bubbles. In the case of condenser and brine tank coils, the tanks are allowed to fill with water, the bubbles of air escaping through the water locating the leak. It is important that the apparatus be thoroughly tight, and while each separate piece is carefully tested in our works, transportation and handling may damage, besides a few joints have to be made on the premises, and it is necessary to go over the entire surface to be sure. While the machine is engaged in pumping air into the system, advantage should always be taken of this opportunity to *purge the system of all dirt and moisture.* To do this properly, valves are provided so the apparatus may be blown out by sections, removing valve bonnets, loosening joints for this purpose, so that it is *positively known* that each pipe, valve and space is strictly clean and purged of all dirt and traces of moisture.

A final test may then be had by pumping a pressure of 300 pounds upon the entire system, and allowing the apparatus to stand for some hours, estimating the leakage, if any, by noting the decrease of pressure as shown by the pressure gauge connected to system. The air pressure will shrink somewhat at first, by reason of losing heat gained during compression by the pumps. As soon as the air parts with its heat and returns to its normal temperature, the gauge will come to a standstill and remain at a fixed point (depending upon the barometer and changing temperature of the room), if the system is tight.

Do not charge the system until it is well cleansed, purged and tight.

PREPARING TO CHARGE.

After machinery has been made perfectly tight, *air must be exhausted from the entire system*, by working the pumps and discharging the air through the valves provided by us for this purpose (found on the pump domes). When the escape of air ceases and the pressure gauges show a full vacuum, it is well to close all outlets and allow the machinery to stand for some time, to test the capacity of the apparatus to withstand external pressure without leakage; in some cases it has been discovered that parts while tight from internal pressure, owing to loose particles lodging over leaks and acting as plugs to prevent leak showing, these same points, when subjected to an external pressure, give way and disclose the leakage.

INTRODUCING THE CHARGE.

Connect the flask of ammonia, as per directions given with each flask, to the charging valve, the gauge still showing a vacuum, close the expansion valve in main liquid pipe connecting receiver to brine tanks. Then open valve on ammonia flask, and allow the liquid to be exhausted into the system. We recommend placing the flask on small platform scales, in order to weigh the contents and *know positively when flask is exhausted.* The machine may be run all this time at a slow speed, with discharge and suction hand stop valves open wide. As one flask is exhausted, place another on scales, and continue until the liquid receiver is shown to be partly full, by the glass gauge thereon. Then shut the charging valve and open and regulate the main expansion valve; the machine is then sufficiently charged to do work, as shown by the pressure gauges and gradual cooling of the brine and frosting of expansion pipe leading to brine tanks coils.

While the system is being charged, water is allowed to flow on the condenser, and men are employed in searching further for leaks, which can readily be detected by sense of smell, each point being again gone over.

Ammonia is a great solvent, and in some cases leaks may be opened up by reason of the gas dissolving substances that may have stopped defective places and withstood the air test.

ACTION OF AMMONIA ON METALS.

Ammonia in itself is a slight lubricant, and has no effect whatsoever on iron or steel, of which our machinery is constructed. It will eventually purge and scour the entire system clean to the metal surfaces, the loose foreign matter being caught in the separators and interceptors provided for this purpose.

AIR IN THE SYSTEM.

Carelessness in regulating the expansion valve and needlessly pumping a vacuum on the brine tank, carelessly allowing leaky stuffing-boxes, may allow air to get into the system, as will also taking the apparatus apart without expelling the air, before the re-introduction of the ammonia gas. The presence of air in considerable quantity is readily noticed by an expert, by the intermittent action of the expansion valve and singing noise, rise of condensing pressure, lose of efficiency in the condenser, etc. Purging valves are provided on the condenser and other points to allow the imprisoned air to escape, and restore the apparatus to its normal condition of pressure and efficiency. See description of Bye Pass on our pumps, to expel air in system, etc., page 69.

PACKING THE PISTON RODS.

This is an important operation, and much depends upon the method employed. Some engineers have a habit of filling the stuffing-box with coils of packing cut so short the rings leave a space and do not join at the ends, and further persist in shoving the packing in with their fingers, and trusting to a vigorous screwing up on the gland to send them home. This is a poor way. Better put each ring of packing in separately and drive it home with a stout packing stick and wooden mallet, break joints with the rings and continue to pack and ram home until box is full. This method calls for a very light pressure of the gland, and in many cases will wear a whole season.

GENERAL INFORMATION.

TO TELL WHEN YOUR COMPRESSOR PUMPS ARE DOING GOOD WORK.

It is a good sign when the main discharge pipes from the pump are hot to the touch, as it indicates efficient action of the compressors. This is due to the mechanical work of compression, manifesting itself in the form of heat, and, taken in connection with a regular action of the valves and steady working pressures, is a good indication.

TO REGULATE TEMPERATURES OR AMOUNT OF WORK DONE.

Increasing speed of machine or increasing back pressure, or both, will effect this result, and *vice versa.*

Increasing back pressure means more gas pumped per stroke, owing to the density of the gas increasing with the pressure. The back pressure is regulated somewhat by the required temperature in brine tank ; there is no difficulty in running at 35 pounds by gauge with our brine tanks, owing to a peculiar distribution and large allowance of evaporating coils. It is best economy, however, to carry the brine no lower than necessary to secure proper temperatures in the rooms.

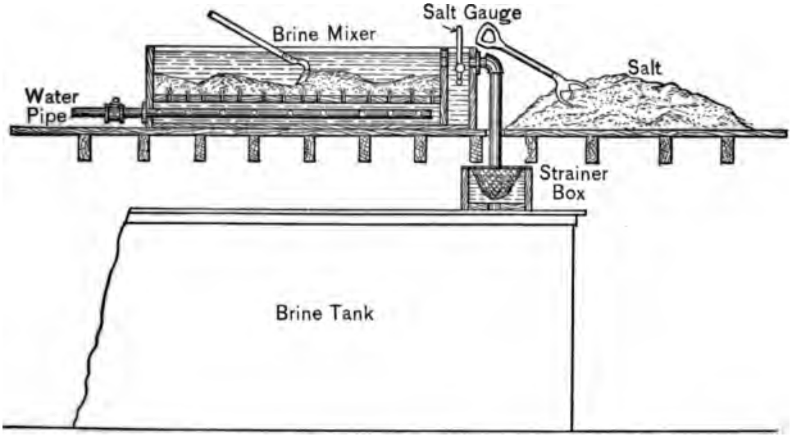
REGULATION OF BACK PRESSURE

is done by the expansion valve placed in the main liquid pipe between the receiver and evaporating coils.

MAKING BRINE SOLUTION FOR BRINE TANKS.

We furnish a set of instruments for testing the density of the brine, and the following instructions should be followed :

Use medium ground pure salt. Buy in bags for convenience in handling. Allow about three pounds of salt for each gallon of water. Continue to dissolve the salt in the brine tank water until it reaches a density of 85 to 90 degrees by salt gauge. If the brine is not full strength, low temperatures cannot be obtained, because the brine will freeze upon the evaporating coils, forming a thick coating of ice, which, to a large extent, acts as insulation. *Salt is simply added to the water in the brine tank to prevent its freezing*, and to insure more intimate contact of the contents of brine tank with evaporating coils. The stronger the brine, the lower temperatures can be obtained without freezing.



Complete Brine Mixing Arrangement
FRICK COMPANY
ENGINEERS
WAYNESBORO, FRANKLIN CO., PA.

MAKING THE BRINE.

In making the brine it is well to use a water-tight box, say 4 ft. wide, 8 ft. long and 2 ft. high, with a perforated false bottom and compartment at end.

Locate the brine maker at a point above the brine tank. Connect the space under the false bottom with your water supply, extending the pipe lengthways of the box and perforated at each side to insure an equal distribution of water over the entire bottom surface, use a valve in water supply pipe. Near the top of the brine maker at end compartment, put in an overflow with large strainer to keep back the dirt and salt, and connect with this a pipe, say 3 in. diameter, with salt catcher at bottom leading into the brine tank. Use a hoe or a shovel to stir the contents. When all is ready partly fill the box with water, dump the salt from the bags on the floor alongside and shovel into brine maker, or dump direct from bags into brine maker as fast as it will dissolve; regulate the water supply to always insure the brine being of the right strength as it runs into the brine tank: this point must be carefully noticed.

Filling the brine tank with water and attempting to dissolve the salt directly therein is not satisfactory, as quantities of salt settle on the tank bottom and coils, forming a hard cake.

It is a good plan, when desired to strengthen the brine, to suspend bags of salt in the tank, the salt dissolving from the bags as fast as required, or the return brine from the pumps may be allowed to circulate through the brine maker, keeping same supplied with salt.

IMPORTANT.

Always see that the pump pistons of our Eclipse compressors are adjusted so they work close against the upper head. Don't forget this, as it is a great saving in power, and may make a big difference in the amount of work you can do.

SELECTING A MACHINE TO SUIT YOUR WORK

is best done by one of our experts, who, from personal inspection of your premises, ascertains the actual conditions under which the machine is to operate, and the work to be done, and with this information selects the proper machinery to meet requirements. Inasmuch as we guarantee that our machinery shall do the work economically and without fail, it is important that no mistake is made in the selection, and that a correct diagnosis of the actual demands be made by a competent person.

APPROXIMATE ALLOWANCES.

The following table will serve as a guide, but bear in mind that the climate, construction and exposure of buildings that are to be refrigerated, character of insulation, management and method of handling work, all have to be taken into consideration.

ALLOW ONE TON REFRIGERATION (24 HOURS) FOR EACH OF THE FOLLOWING DUTIES:

BREWERIES.

Beer wort, 15 barrels cooled on Baudelot 70 degrees to 40 degrees.

Sweet water, 900 gallons ice water cooled 40 degrees.

Cubic space, 6000 to 10,000 cubic feet for entire brewery storage space.

PACKING HOUSES.

Hog chilling, 15 to 24 hogs of 250 pounds each.

Beef chilling, 5 to 7 beeves of 700 pounds each.

Calves chilling, 45 to 55 calves of 90 pounds each.

Sheep chilling, 55 to 70 sheep of 75 pounds each.

In severe cases, allow only one ton fresh killed meat cooled per ton refrigeration.

Storage space, 6000 to 12,000 cubic feet per ton.

COLD-STORAGE WAREHOUSES.

Preserving rooms, 5000 to 8000 cubic feet space.
Chill rooms, 3000 to 5000 cubic feet space.

We would recommend in this connection, that the selection be made by using the allowances giving the largest margin of safety, as this represents the best and most satisfactory practice, and provides for growth of the business and emergencies.

Much of the work to be done can be figured on a heat unit basis, allowing 284,000 heat units per ton refrigerating power each 24 hours, or 11,833 units per hour. To facilitate such calculations, we add a table of specific heats of various substances. The use of this table may need a word of explanation, which we make by giving the definition of *specific heat*, which is the *capacity for heat* of a body, and is the quantity of heat required to *raise or lower that body one degree;* being the ratio of the quantity required to raise or lower an *equal weight of water one degree.*

Table of Specific Heat, Water at 32 Degrees = 1.

Cast iron,	.130	Masonry,	.200	Alcohol,	.659
Brass,	.094	Oak wood,	.570	Oil,	.310
Mercury,	.033	Pine,	.650	Vinegar,	.920
Tin,	.056	Glass,	.197	Strong brine,	.700
Zinc,	.095	Coal,	.241	Ice,	.504
Chalk,	.215	Sulphur,	.202	Water,	1.000
Stone,	.270	Coke,	.203	Air,	.238

To illustrate: One pound of water raised or lowered in temperature one degree Fah. is called one thermal unit. Its specific heat is called 1 at 32 degrees. The amount of heat required to cool 1000 pounds of water 10 degrees would be 1000 pounds × 1 unit × 10 degrees equals 10,000 units, and compared with the units of heat, to cool, say, for instance, one thousand pounds of oil as per table, would be 1000 × .304 units × 10 equals 3040 units, or less than one-third as much as the same weight of water.

Table of Space

ccupied by one pound of various fluids and gases at tmospheric pressure, at 32 degrees Fah., will be found seful in this connection.

Cubic feet for each pound.

VAPORS.

Ammonia,	21.07	Air,	12.38
Oxygen,	11.20	Steam,	19.90
Hydrogen,	178.83	Carbonic acid,	8.10
Nitrogen,	12.72	Ether,	4.77

We also give the following table of weight of substances :—

Weight of Various Substances per Cubic Foot.

	Pounds.		Pounds.
Mercury,	848.7	Olive oil,	57.1
Brine,	77.4	Turpentine,	54.3
Milk,	64.3	Petroleum,	54.9
Sea water,	64.05	Naphtha,	53.1
Pure water,	62.425	Alcohol,	57.4
Linseed oil,	58.7	Benzine,	53.1
Whale oil,	57.4	Wine,	62
Sugar,	40	Ash,	34.3
Soap,	40	Ice,	57.5
Salt,	44	Earth,	93
Dry fruits,	45	Soft coal,	80
Lime,	44	Hard coal,	85
Tobacco,	80	Stone,	178
Oil, aver'ge,	56	Masonry,	143
Eggs,	25	Sand,	119
Fruit,	22	Cast iron,	466
Butter,	58.7	Wrought iron,	487
Fat,	58	Brass,	505
Oak, white,	26	Charcoal,	25.3
Pine, yel'w,	20.6	Lead,	567
Vinegar,	67.5	Beer,	64.62
Beef fat,	57.68	Snow,	5.2
Hog fat,	58.50	Ammonia (28%),	55.68

INFORMATION ABOUT IRON (STEAM, GAS OR BRINE) PIPE.

Inside Diameter.	Outside Diameter.	External Circumference.	Length of Pipe per sq. ft. of Outside Surface.	Internal Area.	External Area.	Length of Pipe containing one Cubic Foot.	Weight per foot of Length.	No. of Threads per Inch of Screw.	Contents in *Gallons per foot.	Weight of Water per foot of Length.
Inches.	Inches.	Inches.	Feet.	Inches.	Inches.	Feet.	Lbs.			Lbs.
⅛	.40	1.272	9.44	.012	.129	2500.	.24	27	.0006	.005
¼	.54	1.696	7.075	.049	.229	1385.	.42	18	.0026	.021
⅜	.67	2.121	5.657	.110	.358	751.5	.56	18	.0057	.047
½	.84	2.652	4.502	.196	.554	472.4	.84	14	.0102	.085
¾	1.05	3.299	3.637	.441	.866	270.	1.12	14	.0230	.190
1	1.31	4.134	2.903	.785	1.357	166.9	1.67	11½	.0408	.349
1¼	1.66	5.215	2.301	1.227	2.164	96.25	2.25	11½	.0638	.527
1½	1.9	5.969	2.01	1.767	2.835	70.65	2.69	11½	.0918	.760
2	2.37	7.461	1.611	3.141	4.430	42.36	3.66	11½	.1632	1.356
2½	2.87	9.032	1.328	4.908	6.491	30.11	5.77	8	.2550	2.116
3	3.5	10.996	1.091	7.068	9.621	19.49	7.54	8	.3673	3.049
3½	4.	12.566	.955	9.621	12.566	14.56	9.05	8	.4998	4.155
4	4.5	14.137	.849	12.566	15.904	11.31	10.72	8	.6528	5.405
4½	5.	15.708	.765	15.904	19.635	9.03	12.49	8	.8263	6.851
5	5.56	17.475	.629	19.635	24.299	7.20	14.56	8	1.020	8.500
6	6.62	20.813	.577	28.274	34.471	4.98	18.76	8	1.469	12.312
7	7.62	23.954	.505	38.484	45.663	3.72	23.41	8	1.999	16.662
8	8.62	27.096	.444	50.265	58.426	2.88	28.34	8	2.611	21.750
9	9.68	30.433	.394	63.617	73.715	2.26	34.67	8	3.300	27.500
10	10.75	33.772	.355	78.540	90.792	1.80	40.64	8	4.081	34.000

* The Standard U. S. gallon of 231 cubic inches.

TABLE OF PROPERTIES OF SATURATED STEAM.

Pressure per square inch by gauge.	Temperature in Fahrenheit degrees.	Latent heat in heat units.	Total heat in heat units from water at 32° F.	Relative volume or cubic feet of steam from one cubic foot of water.
5	227.917	954.415	1151.454	1220.3
10	240.000	945.825	1155.139	984.8
15	250.245	938.925	1158.263	826.8
20	259.176	932.152	1160.987	713.4
25	267.120	926.472	1163.410	628.2
30	274.296	921.334	1165.600	561.8
35	280.854	916.631	1167.600	508.5
40	286.897	912.290	1169.442	464.7
45	292.520	908.247	1171.158	428.5
50	297.777	904.462	1172.762	397.7
55	302.718	900.899	1174.269	371.2
60	207.388	897.526	1175.692	348.3
65	311.812	894.330	1177.042	328.3
70	316.021	891.286	1178.326	310.5
75	320.039	888.375	1179.551	294.7
80	323.884	885.588	1180.724	280.6
85	327.571	833.914	1181.849	267.9
90	331.113	880.342	1182.929	265.5
95	334.523	877.865	1183.970	246.0
100	337.814	875.472	1184.974	236.3
105	340.995	873.155	1185.944	227.6
110	344.074	870.911	1186.883	219.7
115	347.059	868.735	1187.794	212.3
125	352.757	864.566	1189.535	199.0
135	358.161	860.621	1191.180	187.5
145	363.277	856.874	1192.741	177.3
155	368.158	853.294	1194.228	168.4
165	372.822	849.869	1195.650	160.4
175	377.291	846.584	1197.013	153.4
185	381.573	843.432	1198.319	147.1
235	401.072	831.222	1203.735	114
285	418.225	819.610	1208.737	96
335	431.956	810.690	1212.580	83
385	444.919	800.198	1217.094	73

NOTE.—By the term Saturated Steam is meant *dry* steam as it is formed in contact with water.

COMPARISONS OF THERMOMETER SCALES.

R. Reaumur or German scale.
C. Centigrade or French scale.
F. Fahrenheit or English scale.

+ Means above zero on each scale.
— Means below zero on each scale.

R.	C.	F.	R.	C.	F.
+80	+100	+212	**+23**	+28.75	+83.75
79	98.75	209.75	**22**	27.50	81.50
78	97.50	207.50	**21**	26.25	79.25
77	96.25	205.25	**20**	25	77
76	95	203	**19**	23.75	74.75
75	93.75	200.75	**18**	22.50	72.50
74	92.60	198.50	**17**	21.25	70.25
73	91.25	196.25	**16**	20	68
72	90	194	**15**	18.75	65.75
71	88.75	191.75	**14**	17.50	63.50
70	87.50	189.50	**13**	16.25	61.25
69	86.25	187.25	**12**	15	59
68	85	185	**11**	13.75	56.75
67	83.75	182.75	**10**	12.50	54.50
66	82.50	180.50	**9**	11.25	52.25
65	81.25	178.25	**8**	10	50
64	80	176	**7**	8.75	47.75
63	78.75	173.75	**6**	7.50	45.50
62	77.50	171.50	**5**	6.25	43.25
61	76.25	169.25	**4**	5	41
60	75	167	**3**	3.75	38.75
59	73.75	164.75	**2**	2.50	36.50
58	72.50	162.50	**1**	1.25	34.25
57	71.25	160.25	**0**	0	32
56	70	158	**—1**	—1.25	29.75
55	68.75	155.75	**2**	2.50	27.50
54	67.50	153.50	**3**	3.75	25.25
53	66.25	151.25	**4**	5	23
52	65	149	**5**	6.25	20.75
51	63.75	146.75	**6**	7.50	18.50
50	62.50	144.50	**7**	8.75	16.25
49	61.25	142.25	**8**	10	14
48	60	140	**9**	11.25	11.75
47	58.75	137.75	**10**	12.50	9.50
46	57.50	135.50	**11**	13.75	7.25
45	56.25	133.25	**12**	15	5
44	55	131	**13**	16.25	2.75
43	53.75	128.75	**14**	17.50	0.50
42	52.50	126.50	**15**	18.75	—1.75
41	51.25	124.25	**16**	20	4
40	50	122	**17**	21.25	6.25
39	48.75	119.75	**18**	22.50	8.50
38	47.50	117.50	**19**	23.75	10.75
37	46.25	115.25	**20**	25	13
36	45	113	**21**	26.25	15.25
35	43.75	110.75	**22**	27.50	17.50
34	42.50	108.50	**23**	28.75	19.75
33	41.25	106.25	**24**	30	22
32	40	104	**25**	31.25	24.25
31	38.75	101.75	**26**	32.50	26.50
30	37.50	99.50	**27**	32.75	28.75
29	36.25	97.25	**28**	35	31
28	35	95	**29**	38.25	33.25
27	33.75	92.75	**30**	35.50	35.50
26	32.50	90.50	**31**	38.75	37.75
25	31.25	88.25	**32**	40	40

LUBRIGATION OF REFRIGERATING MAGHINERY.

It is well to speak of this, for the reason that it is an important subject; and some users of machinery think that a cheap, low grade of oil is really the cheapest. To disabuse their minds of this idea and suggest the necessity of high grade oils, both on the score of economy and to keep the machinery at all times in efficient running order, is our object. We furnish lubricators on all parts for continuous running.

First-class refrigerating machinery calls for the use of at least three different kinds of oil, Nos. 1, 2 and 3, each of high grade.

No. 1. FOR USE IN THE STEAM CYLINDER, and is known in the trade as *cylinder oil.*—This ranges in price from 50 cents to $1.00 per gallon. Good cylinder oil should be free from grit, not gum up the valves and cylinder, should not evaporate quickly on being subjected to heat of the steam, and when cylinder head is removed, a good test is to notice the appearance of the wearing surfaces; they should appear well coated with lubricant, which, upon application of clean waste, will not show a gummy deposit or blacken. Use this oil in a sight-feed cylinder lubricator with regular feed, drop by drop. Leonard and Ellis' Valvoline is a standard cylinder oil.

No. 2. FOR USE ON ALL BEARING AND WEARING SURFACES OF MACHINE PROPER.—An oil that will not gum, not too limpid, with good body, free from grit or acid, and of good wearing quality, flowing freely from the oil cups at a fine adjustment without clogging, and a heavier grade should be used for lubricating the larger bearings.

No. 3. FOR USE IN COMPRESSOR PUMPS.—This oil should be what is called a cold test, or zero oil, of best quality.

Best paraffine oil is sometimes used; as also a clear West Virginia crude oil. This oil, when subjected to a low temperature, should not freeze.

Note.—Inject no oil directly in our compressors. Use sparingly in the stuffing-box, and simply keep the piston rod lubricated by means of the hand pump and gravity feed, as our experience shows that in keeping the piston rod lubricated, the film of oil adhering to the rod introduces into the cylinder a supply of lubricant ample for all requirements.

To Set the Valves of Corliss Engine

ON OUR ECLIPSE REFRIGERATING MACHINES,

and make proper adjustment of valve gear and regulator, please read carefully and follow the instructions here given.

THE STEAM AND EXHAUST VALVES.

Take off the back valve chest cover or bonnets and upon the bore of the seats you will find a mark which is in line with or coincides with the closing edge of the port for that particular valve seat. Look upon the end of the valve and find a mark running towards the centre of valve; this line coincides with the closing edge of valve. Note that in case of the exhaust valve, the valve controls the part leading into the exhaust passage and not the opening from the cylinder downward. The upper edge of the exhaust port is the closing edge, and the outer edges of the steam ports are the closing edges.

THE WRIST PLATE

should now be looked over, and you will find a mark upon the hub of the same, and corresponding marks upon the hub of the wrist plate bracket. Also marks which show the full extent of motion of the wrist plate when it is moved back and forth by the eccentric. The wrist plate should be located exactly central between the four valves, and is so placed in the shop in building the machine, and all adjustments are made and valves properly set, but in taking apart for adjustment it may be possible that the adjustments may be disturbed and need careful going over before attempting to start the engine for the first time.

TO TEST THE MARKS ON WRIST PLATE HUB

connect the eccentric rods and engage or drop the carrier rod upon the wrist plate stud; then rotate the crank or until the steam valve on the same end as the piston is just beginning to open, say 1-32 of an inch—in this position secure the eccentric on the shaft by means of the set screws in the hub (*see in all cases that the steam valves are hooked up or engaged by the cut-off mechanism*), then turn the engine on the opposite centre and see if the steam valve on that end has the same amount of opening; if not, you can make the adjustment by lengthening or shortening the wrist plate rod attached to this valve.

TO ADJUST THE CUT-OFF.

See that the governor and connections are put together properly, and block the governor about half way in the slot; then fasten the reach or cam rod lever so it stands about at right angles to a line drawn midway between the reach rods; then lengthen or shorten the reach rods until the cam or trip levers stand vertical or plumb. The governor and connections now occupy the proper relative positions, and it remains to make the

EXACT ADJUSTMENT

and to equalize the cut-off, so the same amount of steam is admitted at each end of the stroke. Also, lower the governor and observe when the governor is down that the cut-off mechanism does not unhook but allows steam to be taken full stroke—(*right here we would say that it does not appear to be generally known that the Corliss valve motion, when properly made, is provided with a positive closing device which, in case the valve does not trip, positively* *closes the valve before piston reaches the end of the stroke*) —after which place the engine at, say 1-5 of the stroke, which can be done by measuring upon the slide ways from each end, and turning the engine (*with all parts connected up*) until crosshead is fair with the mark, then slowly raise the governor until the cut-off on the end taking steam trips or unhooks, and to ensure this point being accurately determined, it is well to stand by with the hand pressing down upon the dash-pot rod; now block the governor in this position and try the cut-off on the other stroke same distance from the end. After a few trials back and forth and adjusting the length of the cam rods, the cut-off can be made to drop at precisely the same point of stroke. Take care to secure everything permanently when done.

THE DASH-POT ROD

should be adjusted in length so the steam valve arm, resting thereon, when the dash-pot plunger is home, or at the bottom of the pot, is in such a position that the latch is sure to hook over the latch stud and the stud lies midway between the latch die and the closing shoulder. This will insure on the one hand the positive engagement of the latch, and on the other hand prevent the shoulder from jamming down upon the latch stud in steam arm. If the dash-pot rod is too short, the latch will not hook on. Look out for this.

THE DASH POT

is provided with a leather packing in the vacuum plunger underneath the dash pot proper. This should be kept in good condition. To spread the packing introduce some liners of paper inside the flange on cup leather. When leather is adjusted just right, the pot will work promptly and softly. The valve in the air opening is to regulate the amount of air cushion by turning the screw in the escape hole.

THE REGULATOR GAG-POT

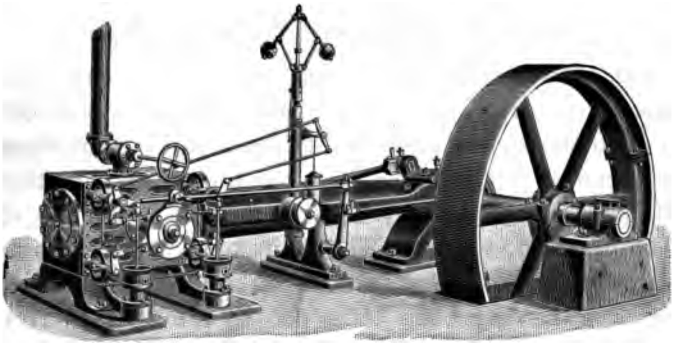
is used on Corliss Engines to prevent over-sensitiveness of the governor and its response to trivial changes. Use kerosene oil in this pot, and remove one or more of the screws in the piston to give freedom of motion. *See that all parts of the governor move freely.*

USING A STEAM ENGINE INDICATOR

to test the correctness of valve setting is the most approved method known, and should be applied in cases where an Indicator can be obtained. Recollect that to adjust the point of cut-off to take same amount of steam at each end, adjust the cam or reach rods. To give more or less steam lead, adjust the wrist plate rods. *Lengthening* them increases the *lap*, and *shortening* them gives more *lead*. The same with the exhaust valves ; the cushion or release being effected thereby. If the eccentric is properly set, it is not necessary to disturb it in ordinary cases. In closing these directions let us impress upon you the necessity of marking everything, so at a glance you can tell if it has been disturbed.

IF THE LATCH DIES

have a tendency to slip, the latch spring may be at fault. It can be made stronger by twisting the spring stud, bringing more tension against the latch. If the stoppage comes from wear, take out the latch or stud die and turn it one-quarter of the way around, thus presenting a new wearing surface.



The Eclipse Corliss Stationary Engine.

THE CYLINDER LUBRICATOR

we furnish has a sight feed and can be nicely regulated, drop by drop. Use good cylinder oil in all cases.

THE STUFFING-BOX PACKINGS

of piston rods and valve stems require your careful attention. There are a number of first-class packings in market, and see to it that you change the packing as often as is needed to prevent cutting of the rods and stems, and that in order to prevent steam leaking past the glands, you do not have to screw them up too tight: if so, clean out the stuffing-boxes and pack fresh. Do not keep putting in new with the old.

LEAVE GOOD ENOUGH ALONE,

and when your engine is running nicely, keep it there and do not attempt to make adjustments when they are not needed. Go slow and sure: better try little by little than overdo, especially with the crank pin and main bearings.

TAKING CARE OF AN ECLIPSE REFRIGERATING MACHINE CORLISS ENGINE.

A good engineer is known by his work, and if all who profess to run an engine were such, we would scarcely need to say

BEFORE STARTING YOUR ENGINE

see that all the water is blown out of the steam pipe by means of the drip valve provided on steam valve elbow; then open the steam valve a little and allow the steam to blow through the cylinder, first one end, then the other, by moving the wrist plate by hand sufficient to let the steam pass through the valves. The cylinder soon becomes warm, and all water is expelled into the exhaust pipe, the exhaust drain cock having been left open to allow it to run off. When ready to start,

LET THE ENGINE MOVE SLOWLY,

until you a[illegible]tisfied everything is all right, then open stop valv[illegible]d le[illegible]me open at all times.

WE DO NOT ADVISE

working the wrist plate motion by hand and running engine backward and forward, except for the purpose of warming up steam cylinder.

WHEN MACHINE IS STOPPED

we would advise wiping it down clean, and an examination of all bearings and parts. Before starting again, see that all oil cups are properly filled and in working order, and all oil holes clear. Use none but the best oil, and use no more of it than is required to keep bearings in good working condition.

CHAPTER XIII.

THESE ARE THE PLOWS, HARROWS AND AGRICULTURAL IMPLEMENTS OUR COMPETITORS SAY WE BUILD, HENCE THEY ARGUE WE CAN'T BUILD REFRIGERATING AND ICE MACHINES.

HERE IS THE ANSWER, LOOK WITHIN.

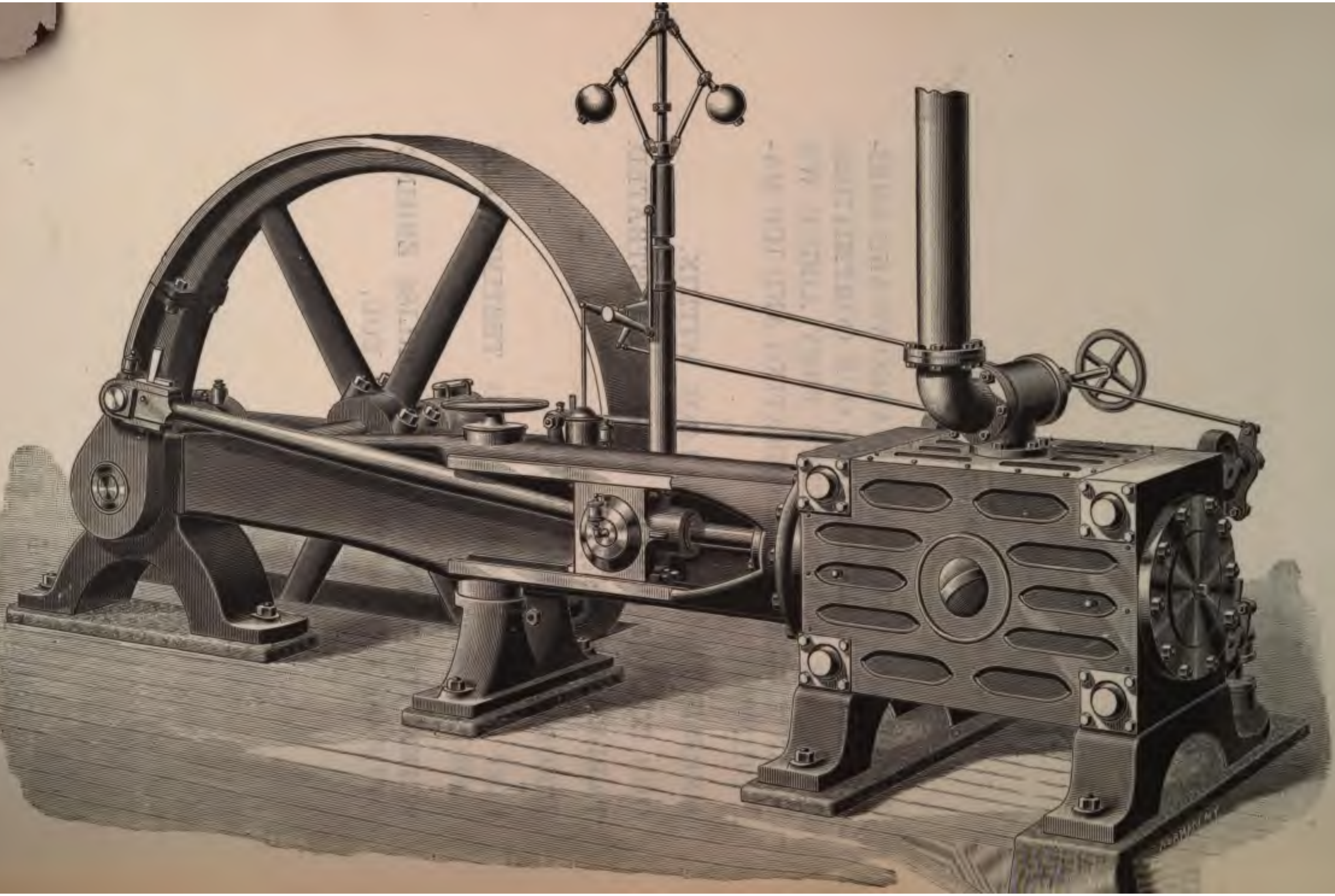
OUR ECLIPSE CORLISS ENGINE ILLUSTRATED.

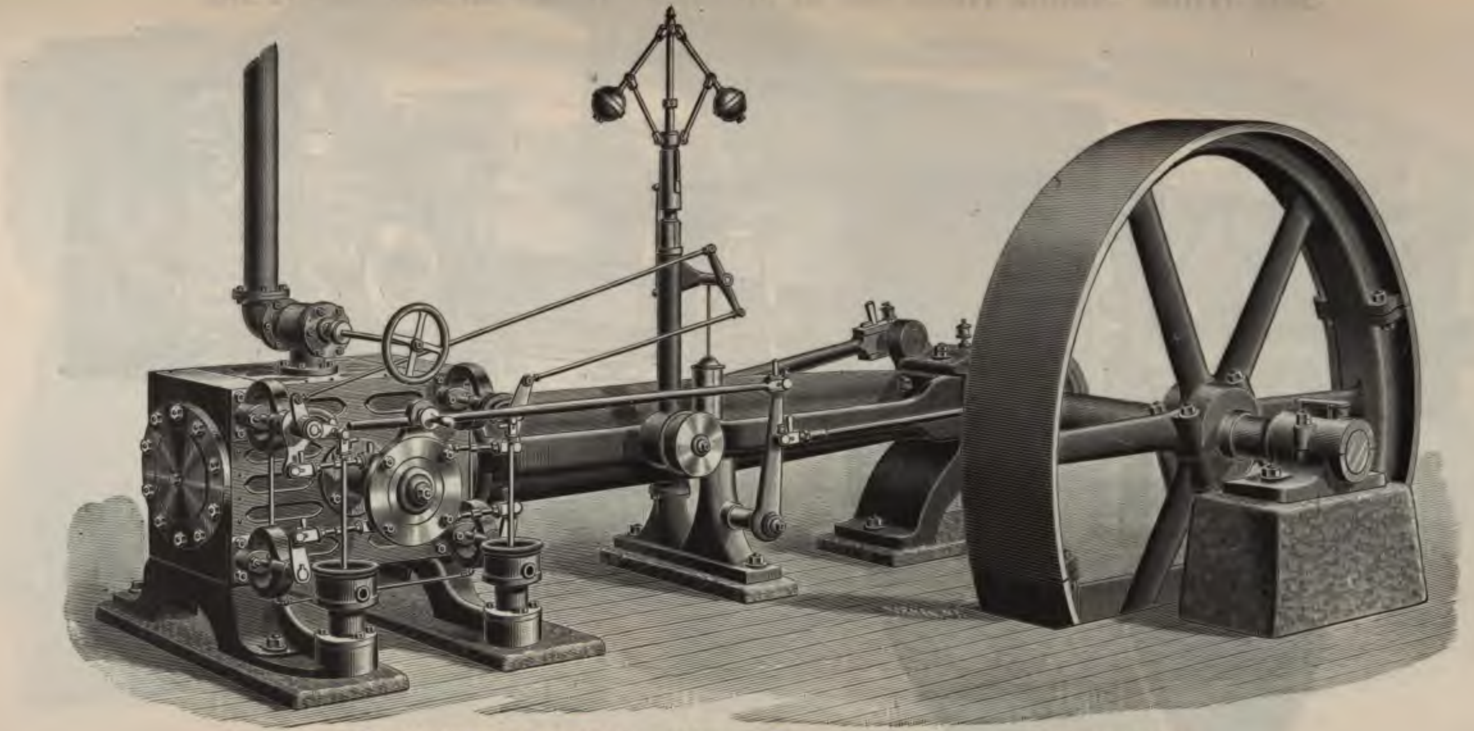
TABLE OF SIZES.

SPECIFICATIONS OF SAME.

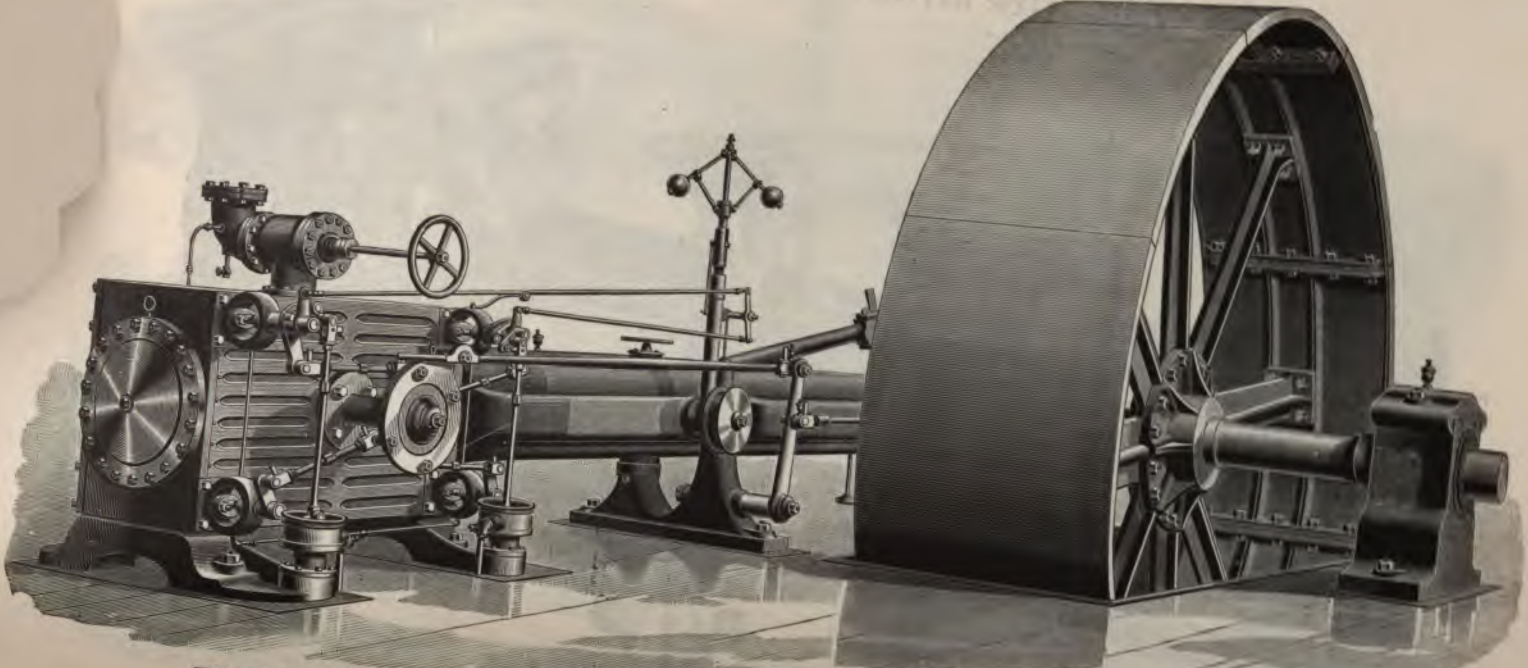
LIST OF REFERENCES AND TESTIMONIALS FROM USERS.

WHEN YOU WANT A GOOD CORLISS ENGINE PLEASE LET US HEAR FROM YOU.

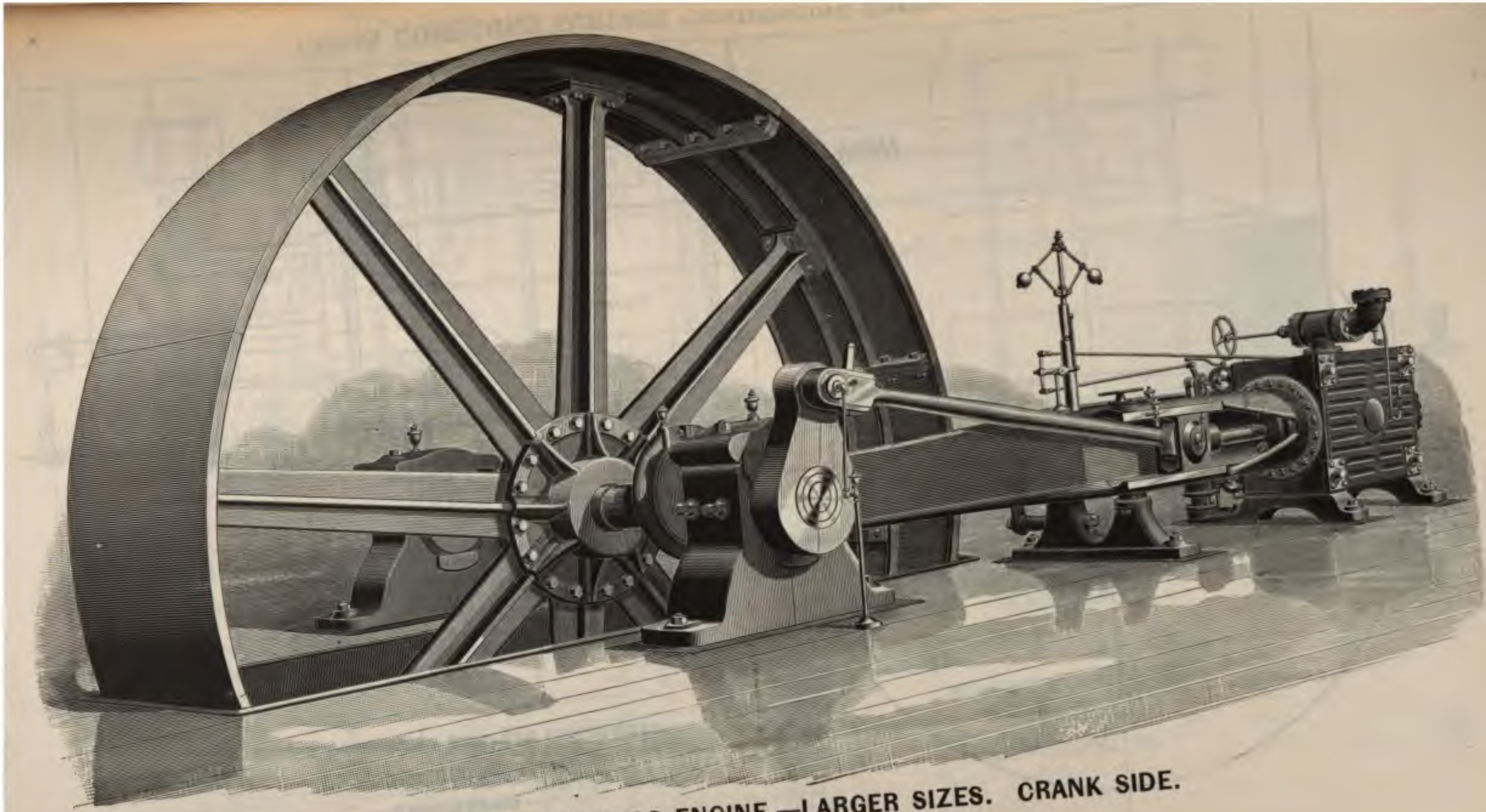




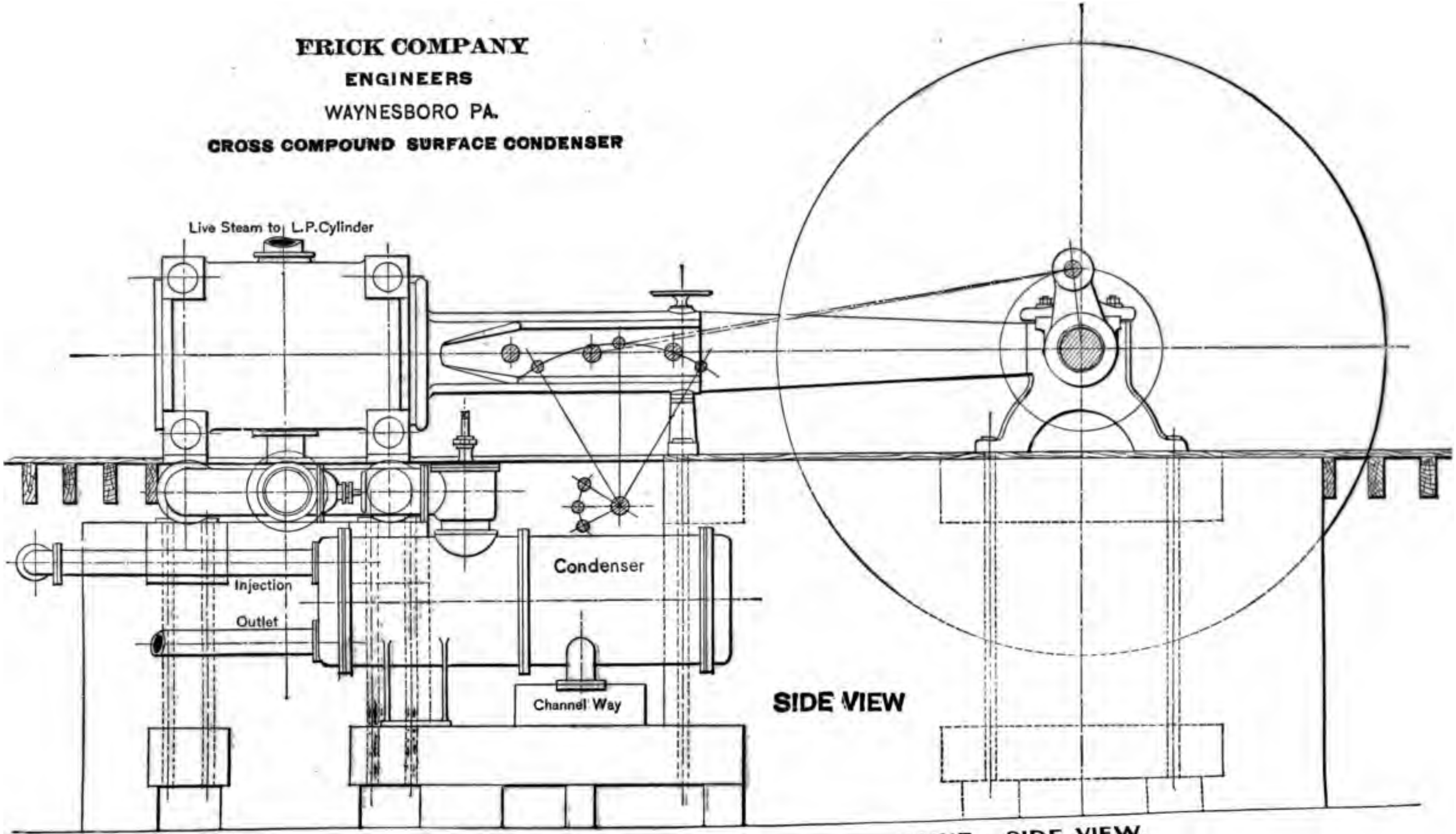
THE ECLIPSE CORLISS ENGINE.—SMALLER SIZES. WHEEL SIDE.



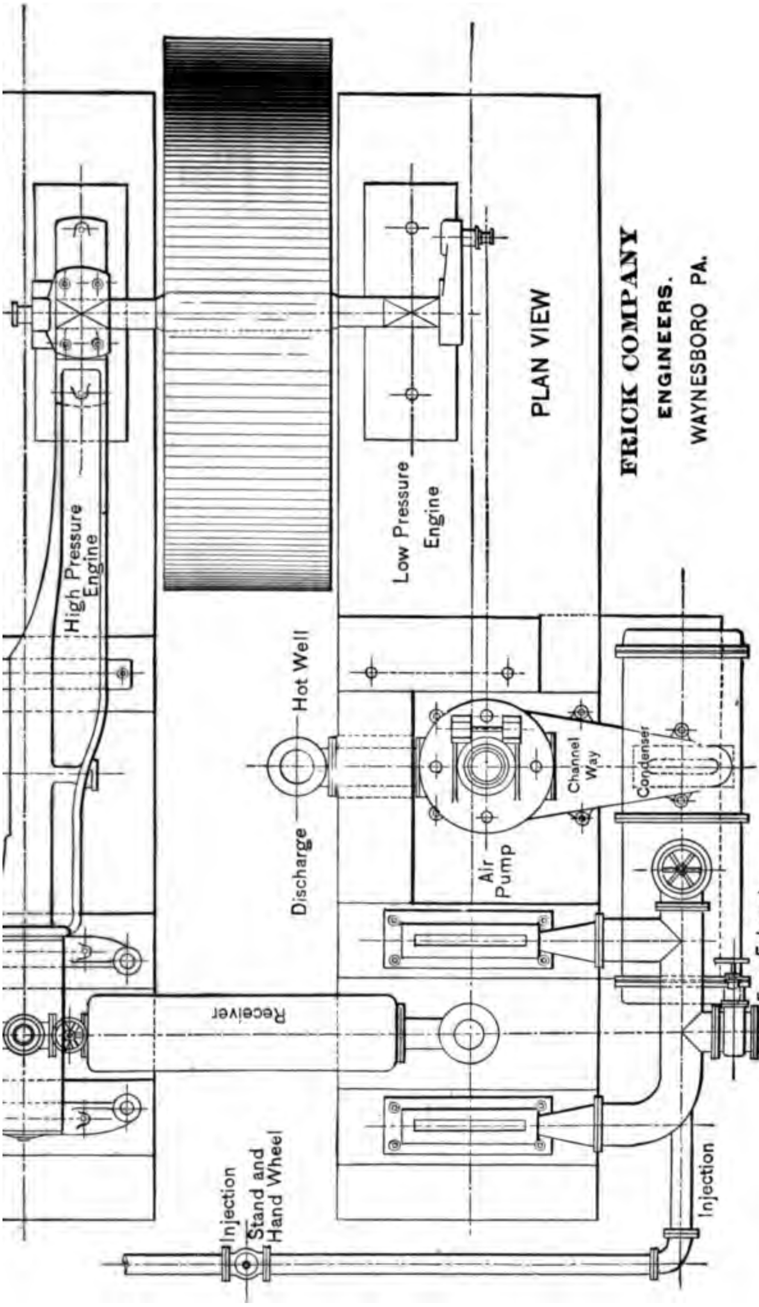
THE ECLIPSE CORLISS ENGINE.—SIZES UP TO 1000 HORSE POWER. WHEEL SIDE.



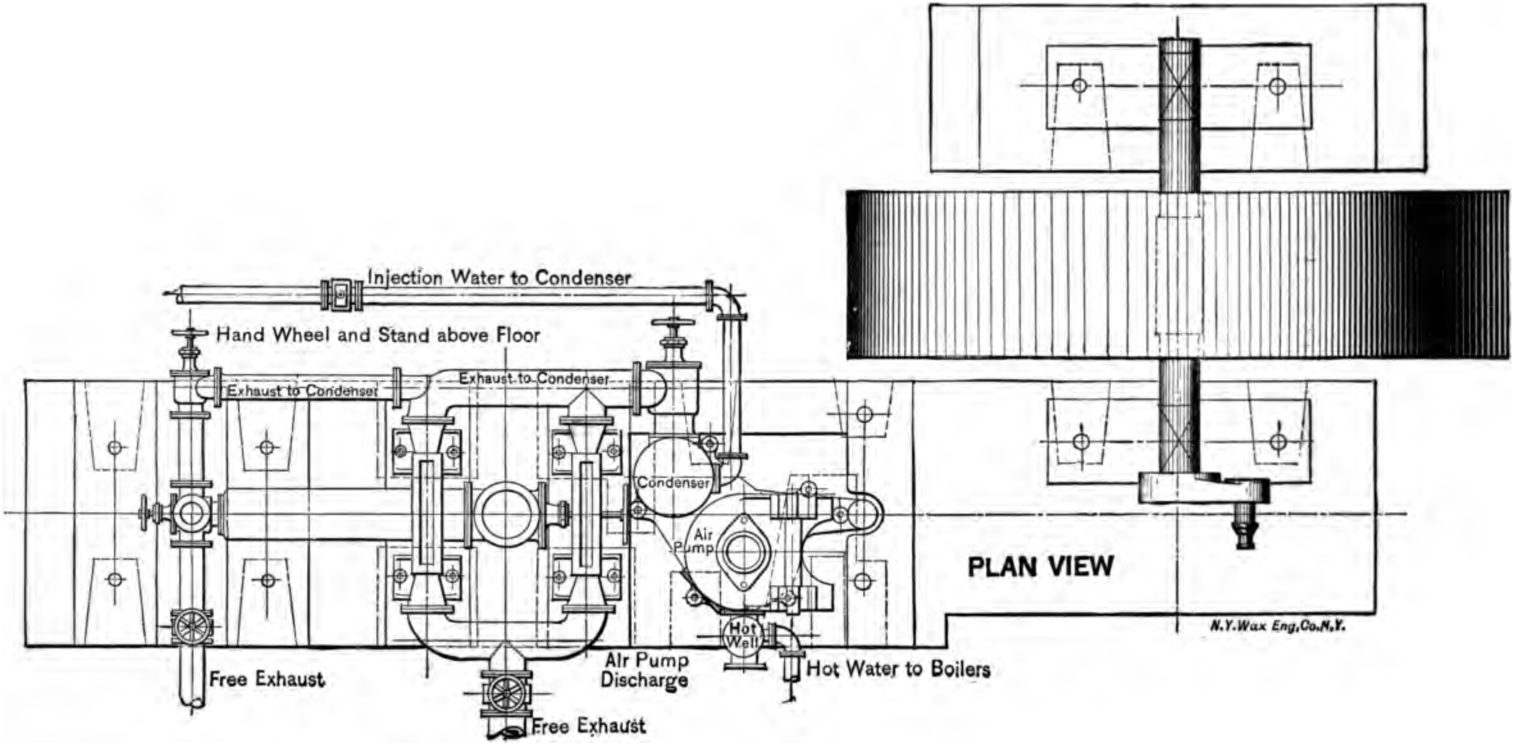
THE ECLIPSE CORLISS ENGINE.—LARGER SIZES. CRANK SIDE.



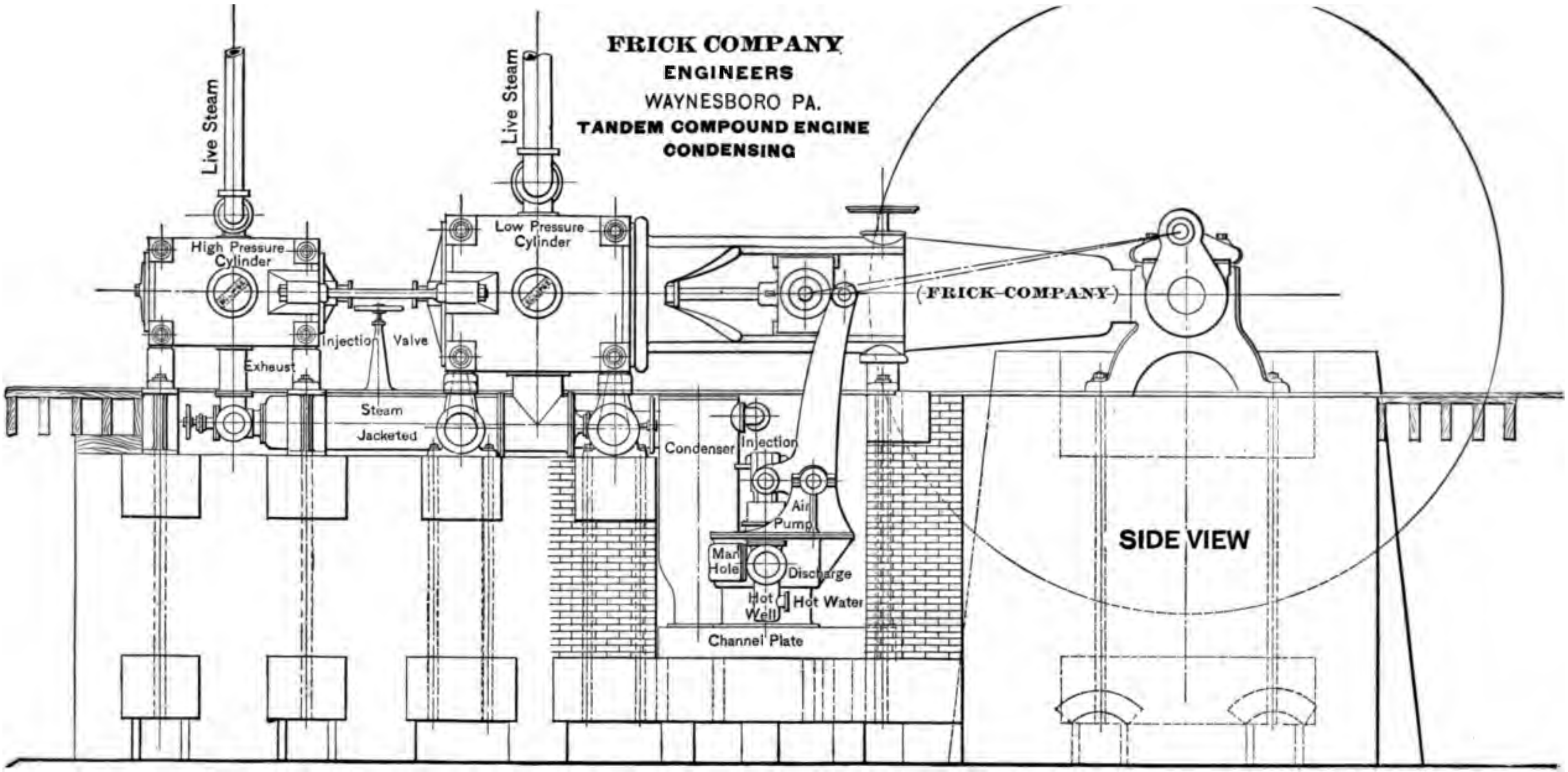
CROSS COMPOUND SURFACE CONDENSING ENGINE. SIDE VIEW



CROSS COMPOUND SURFACE CONDENSING ENGINE. PLAN VIEW.



TANDEM COMPOUND CONDENSING ENGINE. PLAN VIEW.



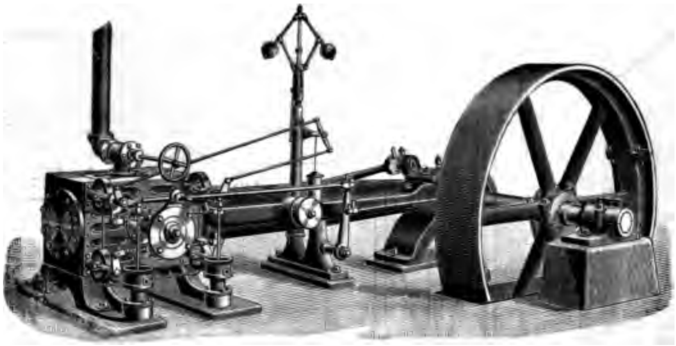
TANDEM COMPOUND CONDENSING ENGINE. SIDE VIEW.

ECLIPSE CORLISS ENGINE.

We manufacture Improved Corliss Steam Engines upon a large scale, and are prepared to furnish all capacities, ranging from 40 to 1000 Horse Power.

OUR CORLISS ENGINES

Possess all the merits of the original, and contain all the various improvements that have made the Corliss Engine so famous for Economy, Regularity of Speed and Long Life.



Corliss Horizontal Stationary Engines,
Corliss Beam Engines,
Corliss Vertical Engines,

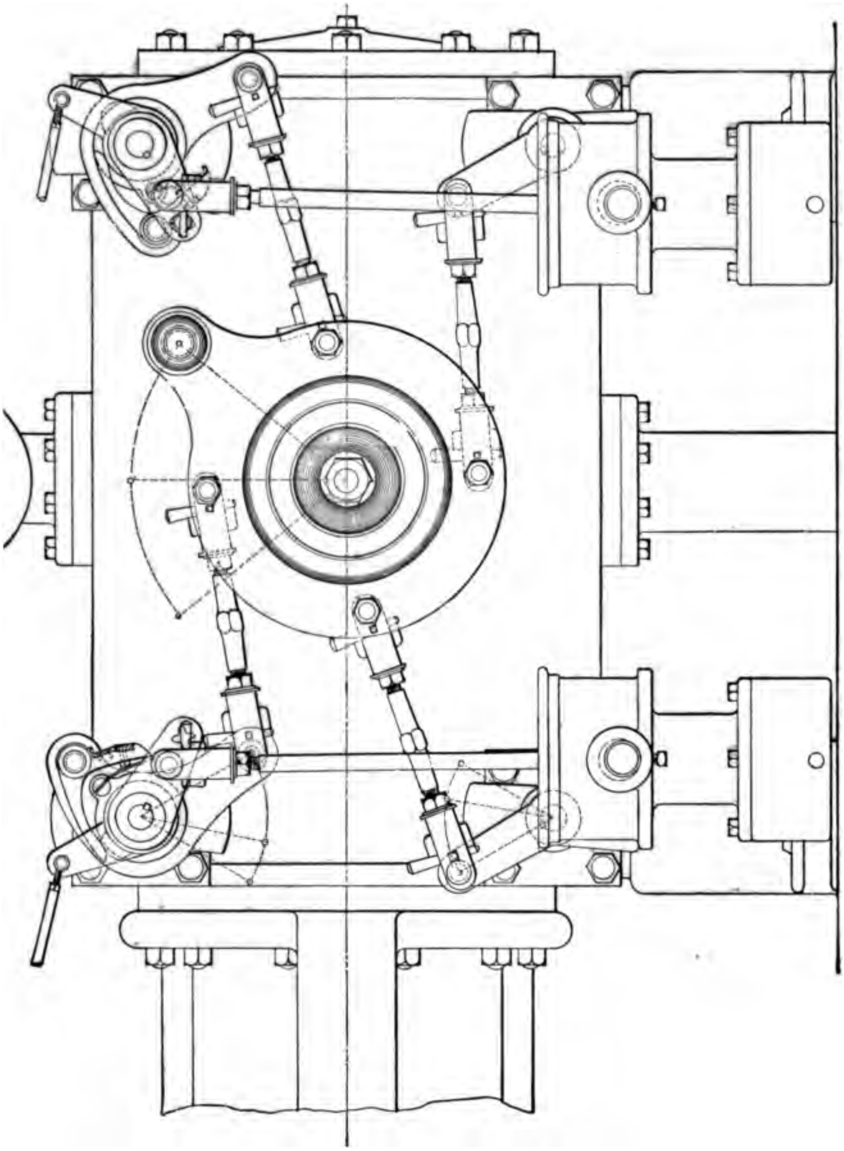
Single or in Pairs, with or without Condensers and Air Pump.

Also, Corliss Compound Engines,

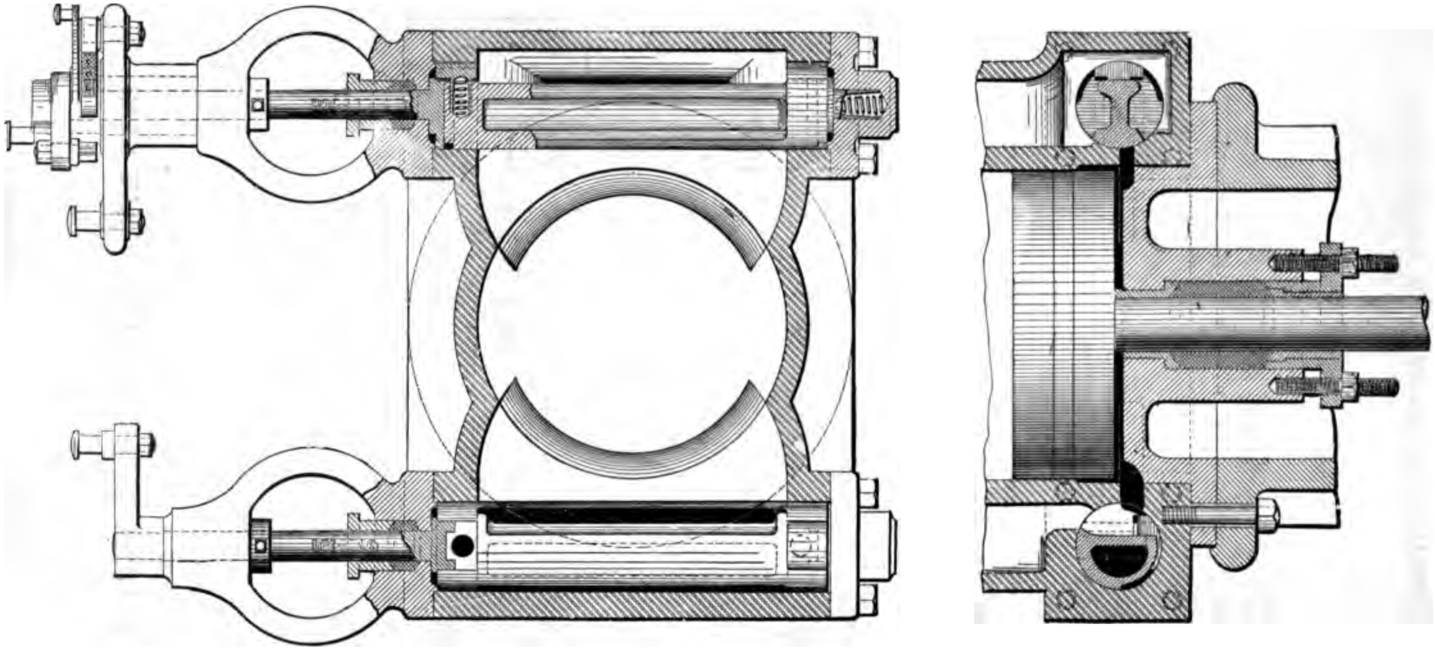
Tandem or Coupled Receiver or Cross Compound.

Our Corliss Engine can be adapted to any service whatever.

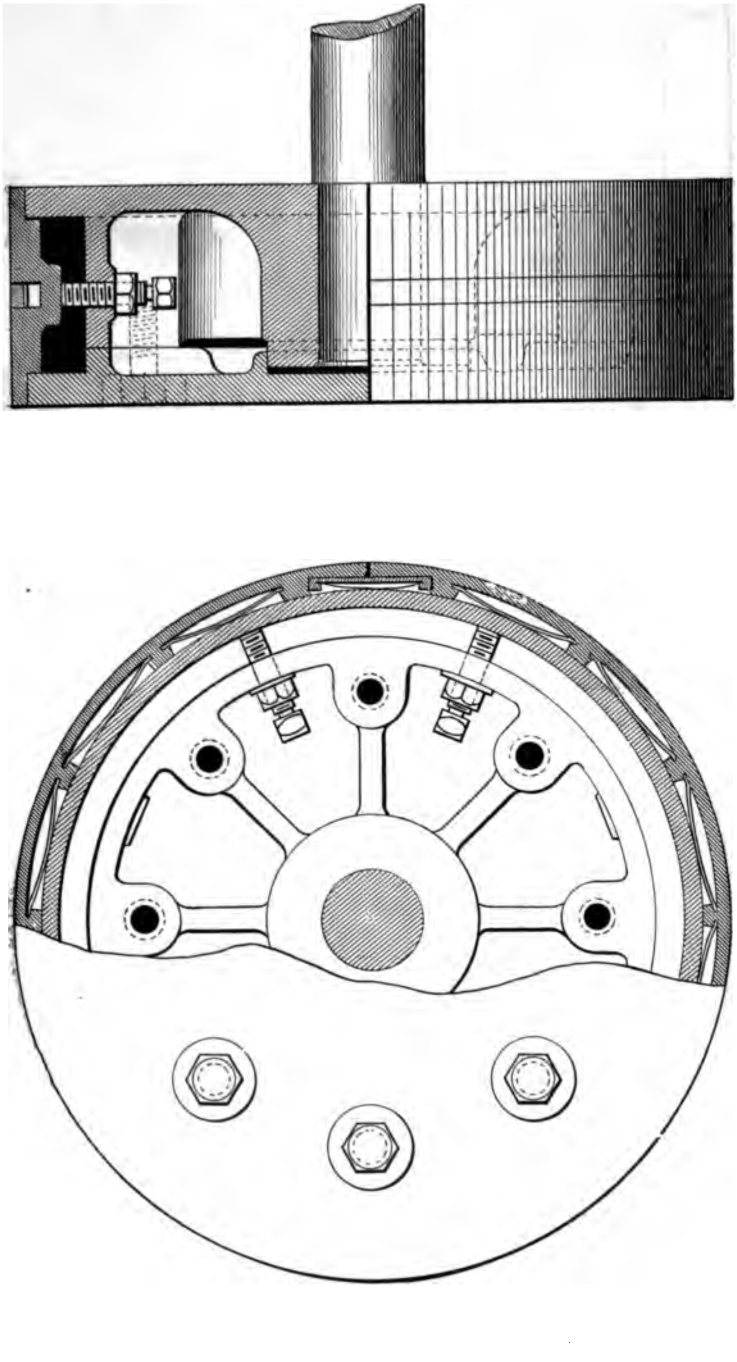
Send for our special pamphlet, illustrating and describing our Eclipse Corliss Engines.



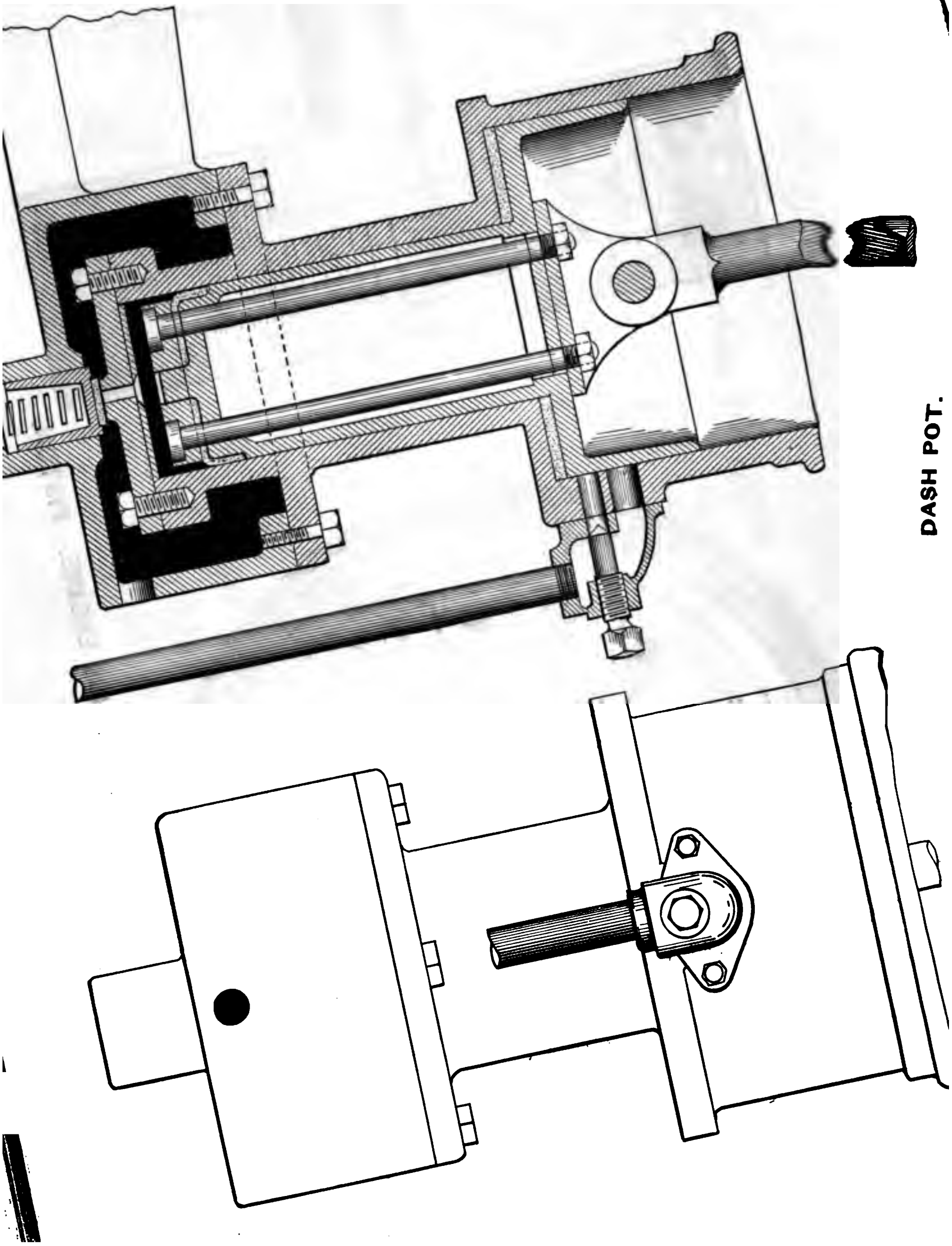
ECLIPSE CORLISS ENGINE. VALVE GEAR.



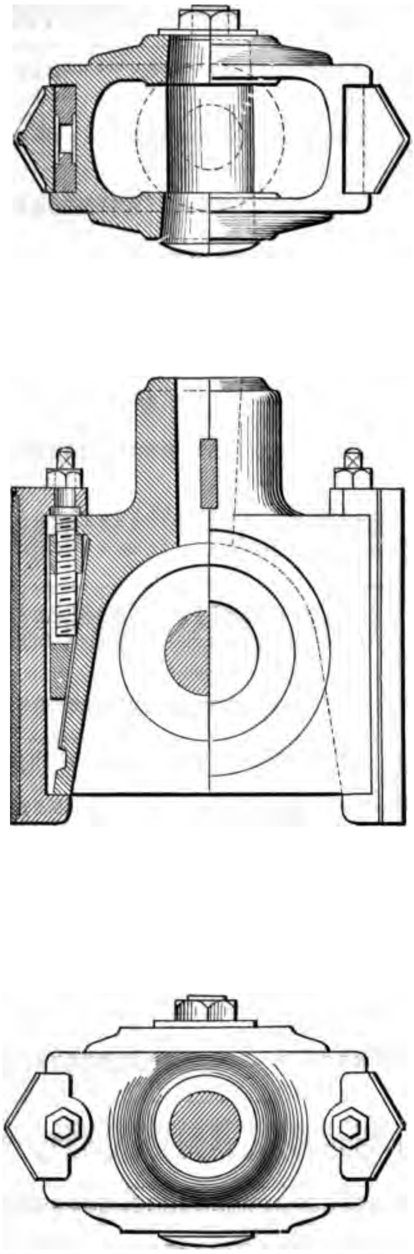
ECLIPSE CORLISS ENGINE. STEAM AND EXHAUST VALVES.



ECLIPSE CORLISS ENGINE. PISTON.



DASH POT.



THE ECLIPSE CORLISS ENGINE. CROSS-HEAD.

HORSE POWER AND DIMENSIONS OF STANDARD ECLIPSE CORLISS ENGINES.

Size of Engines.	Piston Travel. Per Minute.	Revolutions.	H. P. for 1 Pound. M. E. P. at Rev. Given.	Indicated Horse Power 75 lbs. Boiler Press. Point of Cut-off.			Band Wheel.				Shipping weight of Engine with wheel.	Length, end of Cylind'r to centre of Crank Shaft.		Usual length of Crank Shaft.			Centre of Crank Shaft to Foundation.	Steam Pipe diameter.	Exhaust Pipe diameter.	H. P. constant for each Rev.
	Feet.			1-5 30.7 Pounds. M. E. P.	¼ 37.73 Pounds. M. E. P.	3-10 43.43 Pounds. M. E. P.	Diameter. Feet.		Face. Inches.	Weight. Pounds.	Pounds.	Ft.	Inch.	Ft.	Inch.		Inches.	Inches.	Ins.	At 1 lb. M.E.P.
x 24	360	90	.085	26	32	37	8	Diameter and Face changed to order.	13	3,664	12,890	12	4	7	0	Length of Crank Shaft made to suit location.	24			.0095
x 30	450	90	1.071	32	40	46	8		13	5,400	14,300	15	0	7	0		24	3	4	.011
12 x 30	450	90	1.540	46	52	66	9		13	6,000	20,400	14	3	7	6		25	3	5	.017
12 x 36	480	80	1.642	50	62	71	10		15	7,000	22,500	16	3	8	0		25	3	5	.020
14 x 30	450	90	2.097	64	79	91	10		17	8,000	26,000	14	4	8	0		25	3½	5	.027
14 x 36	480	80	2.236	64	84	97	11		19	9,000	27,200	16	4	8	0		25	3½	5	.028
14 x 42	560	80	2.616	80	98	113	12		19	9,000	32,000	18	8	8	6		25	3½	5	.030
16 x 30	425	85	2.588	79	97	112	11		21	10,000	32,000	14	8	8	6		27	4	6	.032
16 x 32	453½	85	2.782	84	103	119	12		21	10,000	28,400	15	1	8	6		27	4	6	.034
16 x 36	480	80	2.923	89	108	129	12		21	11,000	28,400	16	8	8	6		27	4	6	.036
16 x 42	490	70	2.984	91	110	130	12		23	12,000	32,100	18	8	8	6		27	4	6	.042
18 x 36	450	75	3.468	106	130	150	12		25	14,000	35,100	16	8	9	0		27	5	7	.046
18 x 42	490	70	3.776	116	142	164	14		25	15,000	38,200	18	8	9	0		27	5	7	.054
18 x 48	520	65	4.008	123	151	174	16		25	16,000	43,200	20	10	9	0		30	5	7	.062
20 x 42	490	70	4.665	143	176	202	16		31	18,000	48,300	18	10	9	6		30	5	7	.066
20 x 48	520	65	4.949	152	186	215	16		31	20,000	49,500	21	1	9	6		30	5	7	.075
22 x 42	490	70	5.643	173	213	245	14		33	22,000	52,500	19	0	10	0		32	6	8	.080
22 x 48	520	65	5.989	184	226	260	16		37	24,000	56,700	21	6	10	0		32	6	8	.092
24 x 48	520	65	7.127	218	269	309	16		40	27,000	58,000	21	6	11	0		32	7	9	.109
24 x 60	600	60	8.223	252	310	357	18		40	28,000	72,000	26	6	11	0		32	7	9	.137
26 x 48	520	65	8.365	256	315	363	16		40	32,000	74,000	21	6	12	0		32	7	10	.129
26 x 60	600	60	9.652	296	364	419	18		40	34,000	76,000	26	6	12	0		32	7	10	.161
28 x 48	520	65	9.701	298	366	421	18		40	34,000	77,000	21	6	12	6		36	8	10	.150
28 x 60	600	60	11.195	343	422	486	20		40	36,000	84,000	26	8	12	6		36	8	10	.187
30 x 48	520	65	11.138	342	420	483	20		40	38,000	87,000	21	8	13	0		36	8	10	.171
30 x 60	600	60	12.852	394	485	558	22		40	40,000	96,000	26	8	13	0		36	8	10	.214
32 x 48	520	65	12.667	388	475	550	Wheels according to requirements, any size, up to 30 feet diameter, turned for two or more belts.				Weight given on application.	21	8	13	6		36	10	12	.195
32 x 60	600	60	14.616	448	551	634						26	8	13	6		36	10	12	.244
34 x 48	520	65	14.306	439	539	621						22	0	14	0		36	10	12	.220
34 x 60	600	60	16.506	506	622	716						26	8	14	0		36	10	12	.275
36 x 48	520	65	16.036	492	605	696						22	10	14	6		36	12	14	.247
36 x 60	600	60	18.504	568	698	803						26	10	14	6		36	12	14	.309

NOTES.—In selecting an Engine take the lowest rating, 1-5 cut-off. Engines can be run faster or slower than table. The Horse Power varies directly as the speed. Increasing speed 10 per cent. increases power 10 per cent.—and vice versa. Plain Fly Wheels same diameter and weight as Pulleys. The largest rating in Horse Power column, Cut-off 3-10, is the maximum load at 75 pounds boiler pressure, and ought not to be exceeded.

WHAT WE FURNISH WITH OUR ECLIPSE CORLISS ENGINE.

FORM OF PROPOSAL.

We furnish of the very best material and workmanship *one* of our standard "Eclipse" Corliss Automatic Cut-off Engines, having a Cylinder of *blank* inches bore, *blank* inches stroke, with a *blank* Fly Wheel, *blank* feet diameter, *blank* inches face, turned for *blank* belts *blank* inches wide, to weigh about *blank* pounds. Crank Shaft of best forged and hammered wrought iron, *blank* inches diameter, *blank* feet long. Connecting Rod and all small parts of Steel.

Engine to be *blank* Condensing, *blank* Air Pump, *blank* diameter, *blank* stroke, Exhaust Pipe connections from Cylinder to Condenser, provided with straight-way valve and branch to atmosphere with valve, so Engine can be run Condensing or Non-Condensing, as required. First length of Air Pump discharge pipe with Hot Well, Injection Pipe and Valve with polished Iron Column and Hand Wheel.

Cylinder to be lagged with polished iron, packed with mineral wool and fitted with Corliss Valve Gear, Vacuum Dash Pots, and Standard Regulator; Engine to run *blank* Revolutions, and develop economically at that speed, with 75 pounds steam pressure, cut-off at ⅕, *blank* Horse-Power.

We furnish Steam Stop Valve, Foundation Bolts and Plates, Sight Feed Cylinder Lubricator, Oil Pump, Oil Cups, and necessary Wrenches.

We furnish the time of mechanic to erect and put the engine in good running order, ready for your pipe connections and belting.

You will pay our Mechanic's Board and Travelling Expenses and furnish all Necessary Assistance, or Common Labor, and all Masonry and Carpenter Work, and material for Engine Foundations, and floors, from drawings furnished by us.

You will have Engine Foundations ready upon arrival of our mechanic, and if there be any Delay on account of foundations not being ready, or if they be imperfectly constructed, waiting for boilers or pipe connections, or anything for which we are not responsible, time of our mechanic during such delay to be Charged in Account.

Above *Engine* delivered Free on Board at Factory, securely packed for shipment.

We can have the Engine ready for delivery in *blank* days after receipt of order. We Guarantee Workmanship and Materials for One Year, provided no Disarrangement is caused by carelessness or want of attention of person in charge.

OUR ECLIPSE CORLISS ENGINE.

LIST OF RECENT REFERENCES.

Please write to them and learn if they do not sustain our claims that we make the best Corliss Engine in use. Correspondence solicited. Send to us for prices, and ask for any information you need.

☞Corliss cylinders put on old engines—estimates given.

16°x32°	George Seimer, 628, 630 West 30th Street	New York.
18 x42	J. Lichtenstein & Sons, 281–287 Grand Street	New York.
14 x30 14 x30	State Lunatic Asylum	Utica, N. Y.
16 x32	Troy Malleable Iron Works	Troy, N. Y.
19 x42	Armour Packing Co	Kansas City, Mo.
16 x24	Washington Market Co	Washington, D. C.
16 x24	Sprattler & Mennell	Paterson, N. J.
30 x36 32 x36	Armour Packing Co	Kansas City, Mo.
19 x28	Gipps Brewing Co	Peoria, Ill.
19 x24	J. C. Shafer & Co	Baltimore, Md.
16 x24	S. Helldorfer	Baltimore, Md.
16 x36	F. W. Trimble & Co	Baltimore, Md.
16 x24	Henry Fink	Harrisburg, Pa.
22 x32	Herman Lackman	Cincinnati, O.
19 x42	Union Brick Co	Chicago, Ill.
14 x36 14 x36	East Harrisburg Electric Passenger Railway Co.	Harrisburg, Pa.
14 x42	Dawson Bros	Chicago, Ill.
18 x42	J. F. Eifert, 129 Attorney Street	New York.
12 x30	J. M. Horton Ice Cream Co., 115 Park Row	New York.
30 x36	Consumers' Ice Co	New Orleans, La.
20 x48	Navassa Guano Co	Wilmington, N. C.
16 x36	George H. Morrill & Co	Boston, Mass.
18 x42 18 x42	Swift & Co	Chicago, Ill.
14 x36	Henry Smith & Son	Baltimore, Md.
16 x36	Richard Sauer Mfg. Co	Baltimore, Md.
19 x42	Union Brick Co	Chicago, Ill.
16 x32	Chas. A. Gould	Buffalo, N. Y.
18 x36	Standard Cotton Mills	Rock Hill, S. C.
22 x48	Tarboro Cotton Mills	Tarboro, N. C.
16 x24	Union Stock Yards	Peoria, Ill.
22 x32	Little Rock Ice Co	Little Rock, Ark.

19°x24°	Owensboro Ice Co.	Owensboro, Ky.
14 x30	Riverside Chemical Works	Brooklyn, N. Y.
16 x42	Kansas City Glue and Fertilizer Co.	Kansas City, Mo.
18 x42 18 x42	J. M. Thompson	Seattle, Wash. Ter.
14 x30	Gomez & Pearsall	New York, N. Y.
32 x36	Frances Whittaker & Sons	Wichita, Kansas.
16 x24	Bavarian Brewing Co	Covington, Ky.
19 x28	Frank Reisch & Bros	Springfield, Ill.
19 x24	Crystal Ice Co	Springfield, Mo.
16 x28	Emil Winters	Pittsburgh, Pa.
14 x30	F. C. Root	Buffalo, N. Y.
10 x30	Electric Light Co	Wytheville, Va.
28 x60	(Pair) Odell Mfg. Co	Concord, N. C.
16 x42 22 x42	Georgetown and Tenallytown Electric R. R.	Georgetown, D. C.
20 x42	(Condensing) E. L. Hall & Co	Philadelphia, Pa.
12 x36	C. Lambeau & Sons	Chicago, Ill.
12 x30	Albert Cary	Washington, D. C.
12 x30	Warren Mill Co	Warren, Dak.
20 x48	Blue Grass Cordage Co	Georgetown, Ky.
19 x28	Bellevue Brewing Co	Cincinnati, O.
32 x36 32 x36	Chicago Packing and Provision Co	Chicago, Ill.
19 x28	Vogle & Sons	Cincinnati, O.
22 x32	J. C. Hately	Chicago, Ill.
32 x36 32 x36	Geo. Hammond & Co	Chicago, Ill.
16 x24	Calumet Canning Co	Hammond, Ind.
18 x24	Ewing & Beall	Uniontown, Pa.
18 x24	West Chester Ice Co	West Chester, Pa.
19 x28	S. W. Hill	Allegheny, Pa.
24 x32 24 x32	Chautauqua Lake Ice Co	Pittsburgh, Pa.
19 x24	Hagerstown Ice Co	Hagerstown, Md.
10 x24	Steffy & Findley	Williamsport, Md.
10 x24	F. H. Darby	Williamsport, Md.
14 x30	Alberto Malo	Mexico, Mexico.
12 x30	Osborne & Co	Lancaster, Pa.
12 x30	Emmert Flour Mills	Hagerstown, Md.
14 x30	E. P. Hampson & Co	New York City.
10 x24	E. P. Hampson & Co	New York City.
24 x48	Carteret Mfg. Co	Carteret, N. J.
10 x30	J. R. Smith & Co	Purcellville, Va.
20 x48	Armour Packing Co	Kansas City, Mo.
12 x36	E. P. Hampson & Co	Brooklyn, N. Y.
18 x30	Rand Drill Co	New York City.
20 x28	Alberto Malo	Mexico, Mexico.

Other engines in process of erection.

TESTIMONIALS

FROM

USERS OF OUR ECLIPSE CORLISS ENGINES.

281 GRAND STREET, NEW YORK, *September* 4, 1888.

Messrs. E. P. HAMPSON & Co., 36 Cortlandt Street, New York.

Gentlemen:—The 18°x42° Corliss Engine that you erected for us at our present place of business last November, for running our Electric Light Plant, has run from 7 A. M. to 11 P. M., since the first day it was started, without having given any annoyance or trouble, and, so far as we can find, the workmanship, regulation and valve gearing have proved perfect.

Our Electric Plant, consisting of ninety 2000 C. P. Arc Lights, and six hundred 16 C. P. Incandescent Lights, requires fully 150 Horse-Power, and the Engine does this work with apparently the greatest of ease, and with such preciseness of regulation that no variation in the speed is perceptible, whether operating under full, part, or light load, resulting in uniform, steady lights, which is not only very satisfactory, but essential, in our business.

The Engine comes fully up to your representations and guarantees of it, is entirely satisfactory in every respect, and we assure you our experience justifies us in recommending to any one wanting a first-class Engine this, the "Eclipse," as the best one built. Respectfully yours,

J. LICHTENSTEIN & SONS.

J. F. EIFERT, 129–135 ATTORNEY STREET, NEW YORK, *September* 21, 1888.

Messrs. E. P. HAMPSON & Co., New York.

Dear Sirs:—Your letter inquiring about the "Eclipse" Corliss Engine which I bought of you and placed in my factory last April came duly to hand.

I have the pleasure of informing you that the 150 Horse-Power Engine has, in every appointment, justified your representations.

Have found that she does our work with comparative ease, carrying a pressure of 75 pounds of steam on the boiler; and, although a larger Engine than our old one, it is easier to keep steam with 75 pounds on the new one than it was with 90 pounds on the old one, which I was constantly compelled to keep, and had hard work at that.

I would recommend it to any one in want of an engine.

Yours respectfully,

(Signed) JOHN F. EIFERT.

Factory, 628–630 WEST 30TH STREET, NEW YORK, *October* 12, 1887.

Messrs. E. P. HAMPSON & Co., 36 Cortlandt Street, New York.

Gentlemen:—The 16°x32° "Eclipse" Corliss Engine recently purchased of you, and now running, is perfectly satisfactory, and I am pleased with it.

I hereby tender my formal acceptance of the same.

CHRISTIAN HANFELD.

New York, *October* 29, 1888.

E. P. Hampson & Co., 36 Cortlandt Street, New York.

Gentlemen:—The 16°x32° "Eclipse" Corliss Engine has now been running fourteen months, and I must say that during that time we have never had to stop for any cause whatever.

The Engine gives complete satisfaction in every respect.

In regard to its mechanical construction, it is of the best. As regards wear and economy, it excels any other Corliss I have ever run, and I must give yours the preference. DAVID J. REINHARDT, *Engineer.*

Harrisburg, Pa., *December* 3, 1888.

The Frick Company, Waynesboro, Pa.

Gentlemen:—We are pleased to be able to report that the two 14°x36° Corliss Engines furnished us by your Company for our electric station, are giving entire satisfaction in every respect. The fuel consumption averages 100 lbs. per hour of red coal, costing $2.40 per gross ton.

Yours truly, THOS. Q. DENNY, *President.*

Wilmington, N. C., *December* 3, 1888.

Messrs. Frick Company, Waynesboro, Pa.

Gentlemen:—Your favor of the 26th inst. is at hand and noted. It is with pleasure that we can state that the 20°x48° Corliss Engine which we bought of you is giving perfect satisfaction, and we have seen no reason to regret our purchase. The writer, after an extended trip throughout the North, and after visiting the various Corliss Engine manufactories, and after inspecting all kinds of Corliss and automatic engines, decided that your engine had merits as regards strength and finish superior to any he saw, consequently you got our order, and permit me to say that the terms of the contract were all complied with, and that the engine is in all respects exactly as represented. We now have more power, are doing more work, and are saving from $4.50 to $5 per day in fuel over our old plant, and were I going to buy another engine I would buy the "Eclipse Corliss." Yours truly, C. E. BORDEN, *Supt. Navassa Guano Co.*

Chicago, Ill., *December* 5, 1888.

Frick Company, Waynesboro, Pa.

Gentlemen:—It affords us pleasure to inform you that the 14°x42° Corliss Engine we received from you has been working constantly since May first last, and has given us entire satisfaction in every respect.

We do not know of a Corliss Engine at present in the market that we would be willing to exchange for. We have not had to replace or alter any part of the engine since it was first started, and we have never yet had a heated journal.

We take great pleasure in recommending your Engine, and were we going to purchase another engine, we should purchase one from you in preference to any other make we know of. Yours respectfully,

DAWSON BROS.

BALTIMORE, MD., *December* 11, 1888.

FRICK COMPANY, Waynesboro, Pa.

Gentlemen:—It gives us great pleasure to say that the Corliss Engine purchased of you the past summer is giving us great satisfaction, and that it has fully verified all the many points of excellence and economy claimed for it by yourselves at the time we gave order for its construction.

Yours very truly, RICHARD SAUER MFG. CO.

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146 CONGRESS STREET, BOSTON, *August* 18, 1888.

Messrs. E. P. HAMPSON & Co., 36 Cortlandt Street, New York.

Gentlemen:—16°x36° cylinder "Eclipse" Corliss Engine purchased of you, and erected at our factory at Norwood, Mass., early last spring, has run right along every day since it was first started up. It has never given us a moment's trouble of any kind, and what is extraordinary in a new engine, has never had a bearing or pin about it warm enough to melt butter. The valve gearing, regulation, and workmanship throughout, thus far has proved perfect, and the whole machine has so far exceeded your guarantee of it that we are more than pleased with our choice.

One good feature about your Engine, and, we might add, one of the main ones that at the time induced us to buy it, is the abundance of metal put in it, and the fact that it is placed just where it is needed. We think this, in a measure, largely accounts for the Engine doing its work without any heating.

Our experience so far enables us to recommend it to any one wanting a first-class Corliss Engine as being as good as, if not the best, built.

Yours very truly,

(Signed) GEORGE H. MORRILL & CO.,

Manufacturers of Printing Inks, etc.

TROY, N. Y., *September* 9, 1888.

Mr. C. M. MORSE, Department Machinery,

Buffalo International Fair Association, Buffalo, N. Y.

Dear Sir:—Yours of the 10th is at hand. We have a Corliss Engine sold by E. P. Hampson & Co., of New York. This Engine has been in use for the past seven months, and for the first three months was running twenty-two hours a day, and eighteen hours, on an average, per day since, without a stoppage of an hour during this period for any cause whatever.

We find that we use less coal to run our present 90 Horse-Power Engine than was required to run the one replaced of 40 horse-power. The cylinder-jacket and the valves are easily kept steam-tight, and the Engine is the most cleanly piece of machinery of this kind we have ever had any experience with. There is no trouble about pounding, jarring or loosening of parts, causing annoyance, and requiring time and expense to correct.

The only regret we now have is that we did not know sooner that we could get an Engine which would do so well, for we can pay for it in three years at most out of the savings. Yours truly,

(Signed) WM. SLEICHER, JR.,

TROY MALLEABLE IRON CO., *General Manager.*

TROY, N. Y.

CHAPTER XIV.

SOME MORE PLOWS AND AGRICULTURAL IMPLEMENTS, AS OUR COMPETITORS CLAIM.

GENERAL MACHINERY DEPARTMENT OF THE FRICK COMPANY.

UPRIGHT ENGINES—SEE ENGRAVINGS.

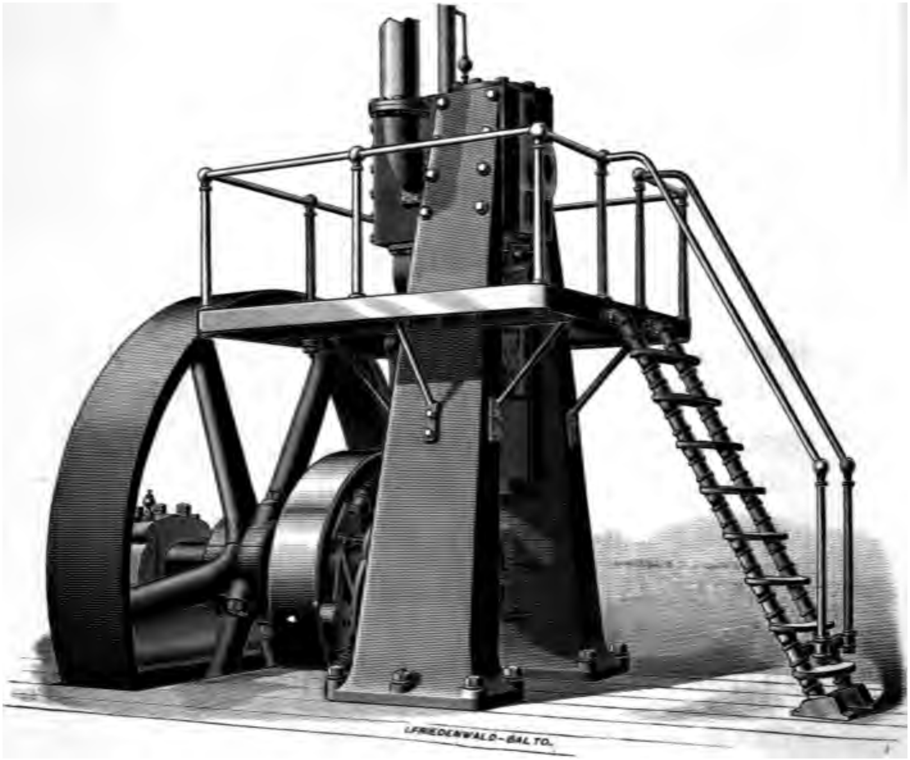
HORIZONTAL PLAIN SLIDE ENGINES, AND TABLE OF SIZES.

ECLIPSE HIGH SPEED AUTOMATIC ENGINES.

STEAM BOILERS, ILLUSTRATED.

IF YOU WANT ANY OF THIS MACHINERY PLEASE WRITE TO US. WE SOLICIT YOUR TRADE.

UPRIGHT AUTOMATIC ENGINES.

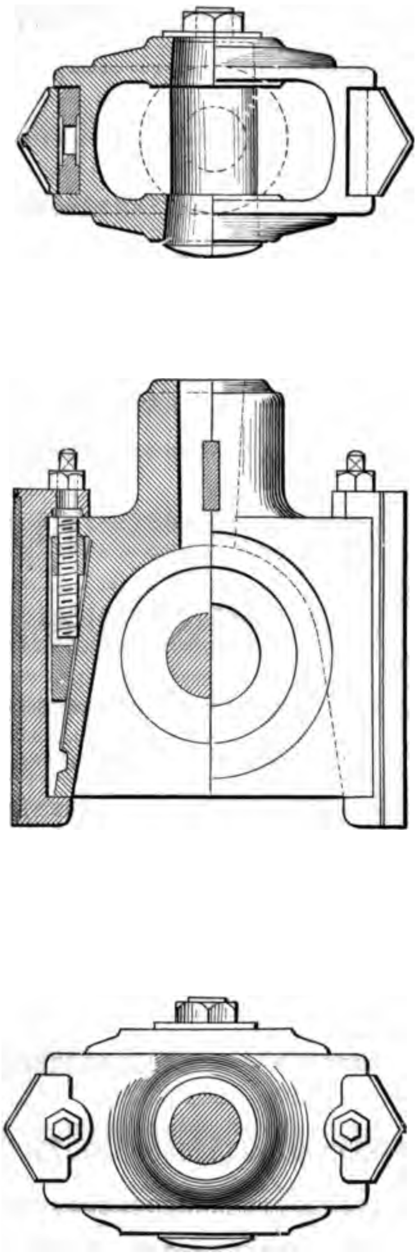

L.FRIEDENWALD-BALTO.

Engine Side.

UPRIGHT AUTOMATIC ELECTRIC LIGHT AND ROLLING MILL ENGINE.

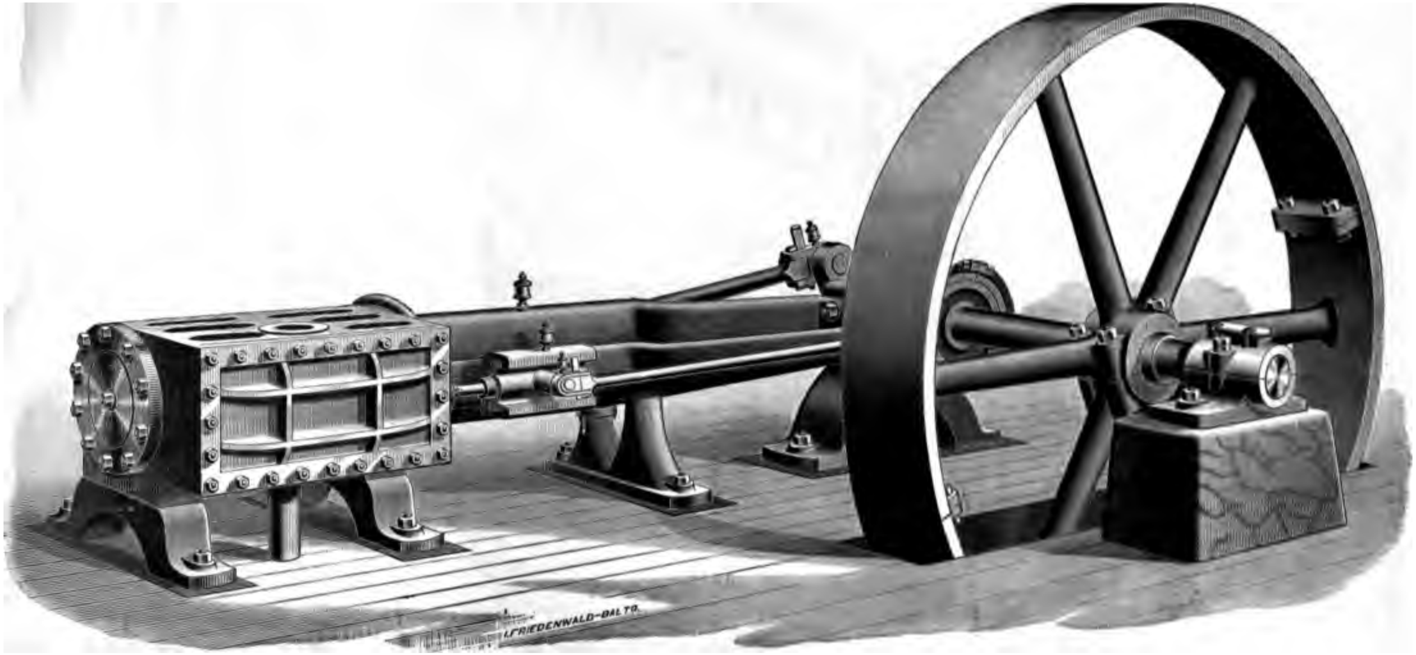
We build Upright Engines of the above design. Sizes ranging from 10 to 48-inch bore of cylinder. They are made with Corliss Cylinder, plain Slide Valve, or with Prof. Sweet's Balanced Valve, with "Eclipse" Automatic Governor, as preferred. Specially adapted for Rolling Mills and Grain Elevators. Made condensing, non-condensing, or compound condensing.

Prices and drawings on application. This is a heavy, strictly first-class Engine.



THE ECLIPSE CORLISS ENGINE. CROSS-HEAD.

LARGE SLIDE VALVE STATIONARY ENGINES. CORLISS GIRDER BED STYLE.

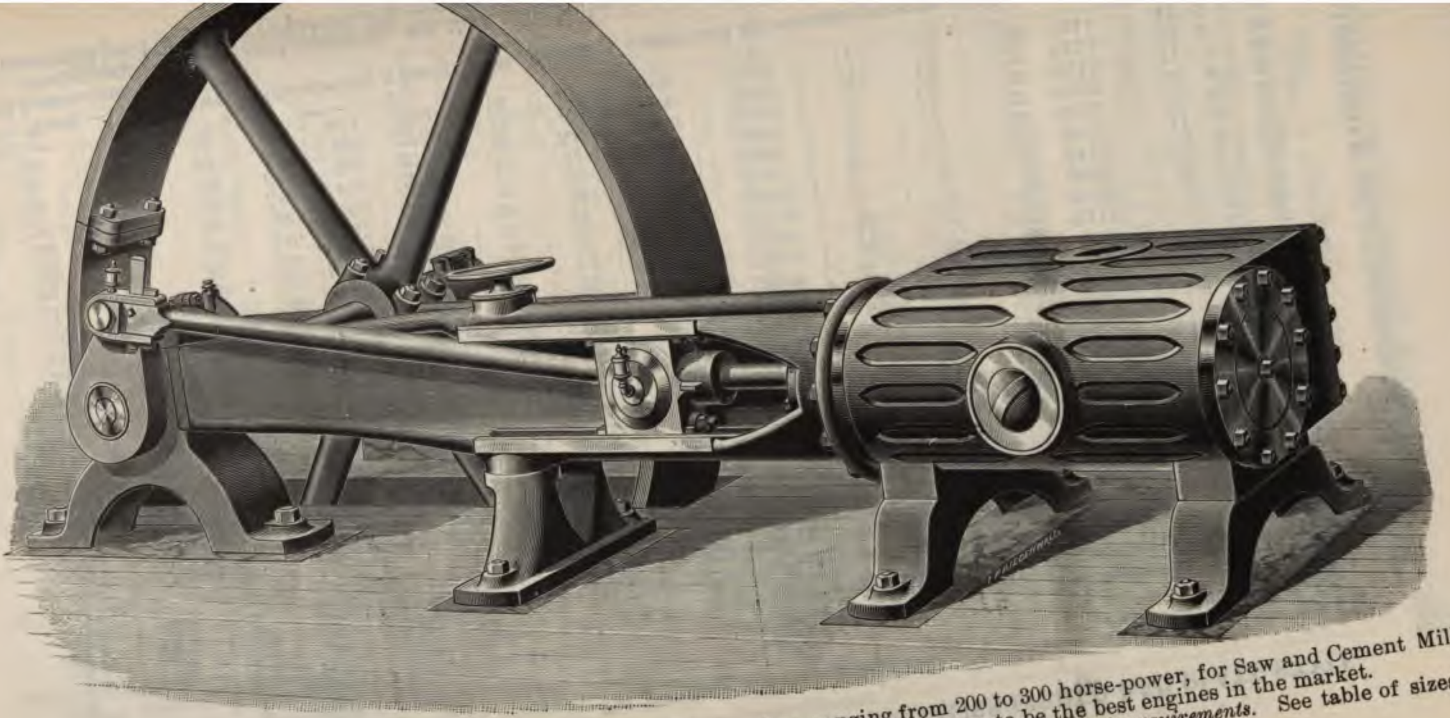

FRIEDENWALD-BALTO.

PULLEY SIDE.

This Engine is specially adapted for use in large Saw Mills, Cement Works, Brick-yards, Oil Mills, Planing Mills, Hoisting and Pumping, Coal Mines, etc., where a Corliss Engine is not used.

The same care and use of good materials and workmanship is used in construction of these engines as in our Standard "Eclipse" Corliss.

We have a full line of patterns, and can supply quickly any size on list. See list, page 260.



During the past season we have sold a number of the heavier sizes, ranging from 200 to 300 horse-power, for Saw and Cement Mill. The owners report, in each case, "Engines giving fine satisfaction"; and claim them to be the best engines in the market. nts a choice between a short and medium stroke. *Speed and diameter of pulley to suit requirements.* See table of sizes,

LIST OF SLIDE VALVE HORIZONTAL STATIONARY ENGINES. CORLISS GIRDER BED PLATE STYLE.

Size of Engine.		Revolutions per Minute.	Piston Travel, Feet per minute.	Horse Power.	Belt Speed.	Fly Wheel.			Approximate Weight with Fly Wheel Complete.	Steam Pipe.	Exhaust Pipe.	Floor Space.			Usual Length of Crank Shafts.		Centre of Crank Shaft to Foundation.
Diameter, Inches.	Stroke, Inches.					Diameter.	Face.	Weight.									
										ins.	ins.	ft.	ins. ft.	ins.	ft.	ins.	ins.
10	20	120	400	38	3000	8	9	2260	10200	2½	3½	14	3x 9	6	7	0	24
12	20	120	400	54	3000	8	11	3000	10900	3	4	14	3x 9	6	7	0	24
12	24	112½	450	62	3180	9	11	3600	11100	3½	4	15	6x10		7	0	24
13	24	112½	450	72	3180	9	12	4000	12000	3½	4½	15	6x10		7	0	24
14	24	112½	450	84	3534	10	12	4400	16700	3½	4½	17	9x10		7	0	25
15	24	112½	450	96	3534	10	13	4900	21400	3½	5	17	9x10		7	0	25
16	24	112½	450	110	3887	11	12	5200	25400	4	5½	17	9x10		7	0	25
18	30	100	500	154	3769	12	13	8400	27500	4½	6	19	9x10		7	0	27
18	36	90	540	166	3675	13	17	10200	29600	4½	6	21	9x10		7	0	27
20	30	100	500	190	3769	12	20	10300	31700	5	6½	21	6x10	11	8	3	27
20	36	90	540	205	3675	13	21	12600	33800	5	6½	23	6x10	11	8	3	27
22	30	100	500	230	3769	12	24	12500	35900	5½	7	22	6x12		8	3	30
22	36	90	540	250	3769	13	24	15400	39700	5½	7	24	6x12		9	3	30
24	36	90	540	296	3675	13	30	18000	43500	6	8	24	6x13		10	6	32
24	42	80	560	305	3769	15	24	18200	46200	6	8	26	6x13		9	9	32
26	36	90	540	347	3675	13	34	20400	48400	7	9	24	6x13		11	0	32
26	42	80	560	360	3769	15	30	21400	49800	7	9	26	6x13		10	9	32
28	42	80	560	418	3769	15	34	24000	54100	7	9	27	6x13	0	11	9	36
28	48	75	600	448	3769	16	34	27900	70400	7	9	29	6x13	6	11	9	36
30	42	80	560	480	3769	15	40	29800	72800	7½	10	27	6x14		12	9	36
30	48	75	600	514	3769	16	40	34000	77000	7½	10	29	6x14		12	9	36

Note.—Horse power calculated on a basis of 80 pounds of steam and an average pressure of 40 pounds. This rating gives the best economy.

Important.—For the best economy, see that your boiler is 5 to 15 per cent. more than the rated power of the engine. Increasing speed of engine 10 per cent. increases horse power 10 per cent., and vice versa.

See Engravings of Engines, Pages 258 and 259.

TABLE OF DIMENSIONS OF ECLIPSE AUTOMATIC ENGINES. MOUNTED ON HIGH BASE.

Size of Engine.						Horse Power. 80 pounds steam cut-off at ¼ stroke. 40 pounds M. E. P.										Pipes.	
Diameter, inches.	Stroke, inches.	Revolutions per minute, Minimum.	Revolutions per minute, Maximum.	Piston travel per minute, Minimum.	Piston travel per minute, Maximum.	Min.	Max.	Fly Wheel, Diameter, inches.	Face, inches.	Driving Pulley, Diameter, inches.	Face, inches.	Belt Speed, Minimum.	Belt Speed, Maximum.	Weight of Engine, complete.	Floor Space, Length and Width. ft. in. ft. in.	Steam, inches.	Exhaust, inches.
5	10	225	337	375	561	9	14	42	8	28	8	1649	2470	3600	7 0 x 4 0	1½	2
6	10	225	337	375	561	13	19	42	8	28	8	1649	2470	3800	7 0 x 4 0	2	2½
7	12	210	315	420	630	19½	29	48	8	36	8	1979	2967	4200	9 0 x 4 7	2	3
8	12	210	315	420	630	25½	37	48	8	36	8	1979	2967	4600	9 0 x 4 7	2½	3½
9	14	200	300	466	700	36	54	60	12	42	8	2198	3297	7000	10 4 x 5 10	2½	3½
10	14	200	300	466	700	44	66	60	12	42	8	2198	3297	7600	10 4 x 5 10	2½	3½
11	16	180	270	480	720	55	82	72	14	48	14	2260	3391	9400	11 6 x 6 0	3	4
12	16	180	270	480	720	65½	98	72	14	48	14	2260	3391	10000	11 6 x 6 0	3	4
13	18	160	240	480	720	76	114	72	14	72	14	3014	4521	12300	11 9 x 6 3	3½	4½
14	18	160	240	480	720	89	133	72	14	72	14	3014	4521	13000	11 9 x 6 3	3½	4½

The above engines are carefully adjusted and tested for regulation and smooth running before shipment, and can be run at any required speed.

They are mounted upon a high cast-iron base which allows the fly wheels to clear the floor.

We can supply them with two large fly wheels, two small fly wheels, or one large fly wheel and driving pulley as named in table. Where small wheels are used the weight of same is made ample for the requirements of good regulation and uniform speed.

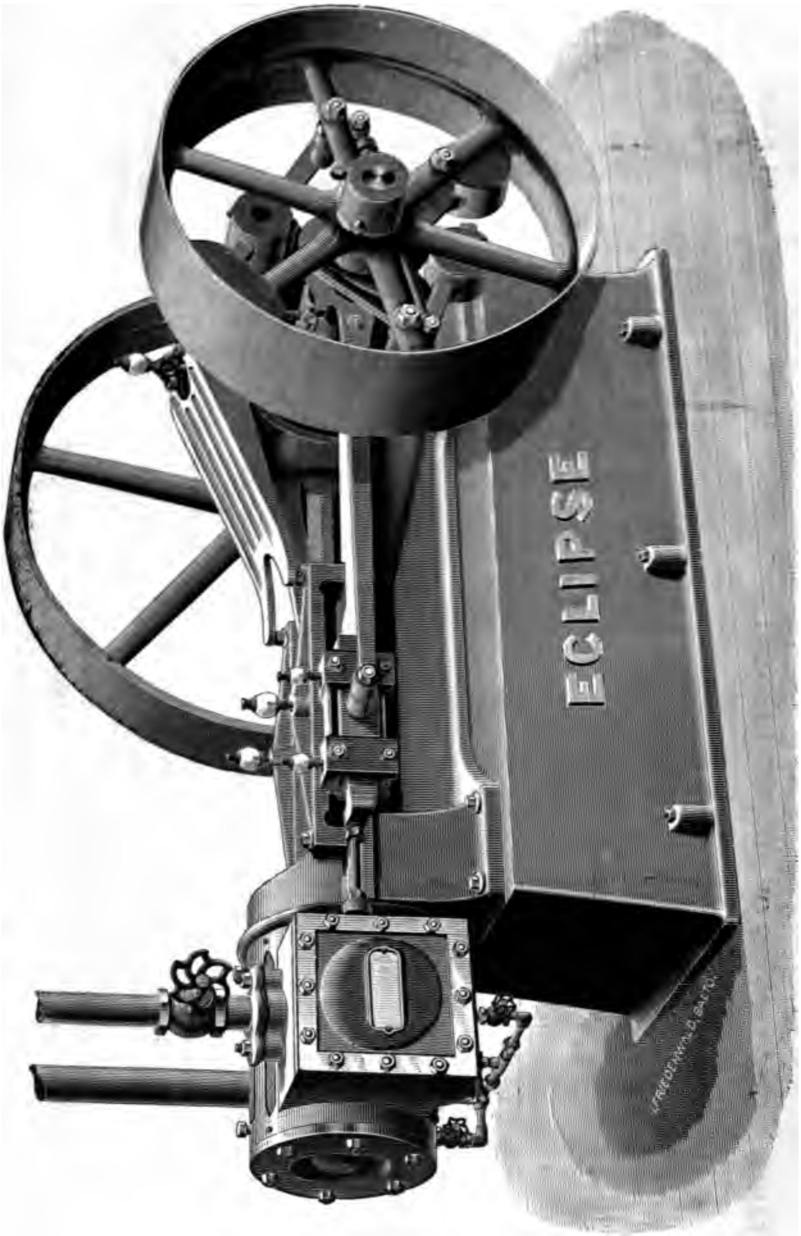
These engines are of first-class special designs, and are fitted with Sweet's Patent Balanced Valve and our Patent "Eclipse" Automatic Governor. Increase of speed increases power in same proportion.

Use boilers 10 to 20 per cent. larger than power given in table, for best economy.

See Engraving, Pages 262-263.

ECLIPSE AUTOMATIC ENGINE.

(PATENTED.)



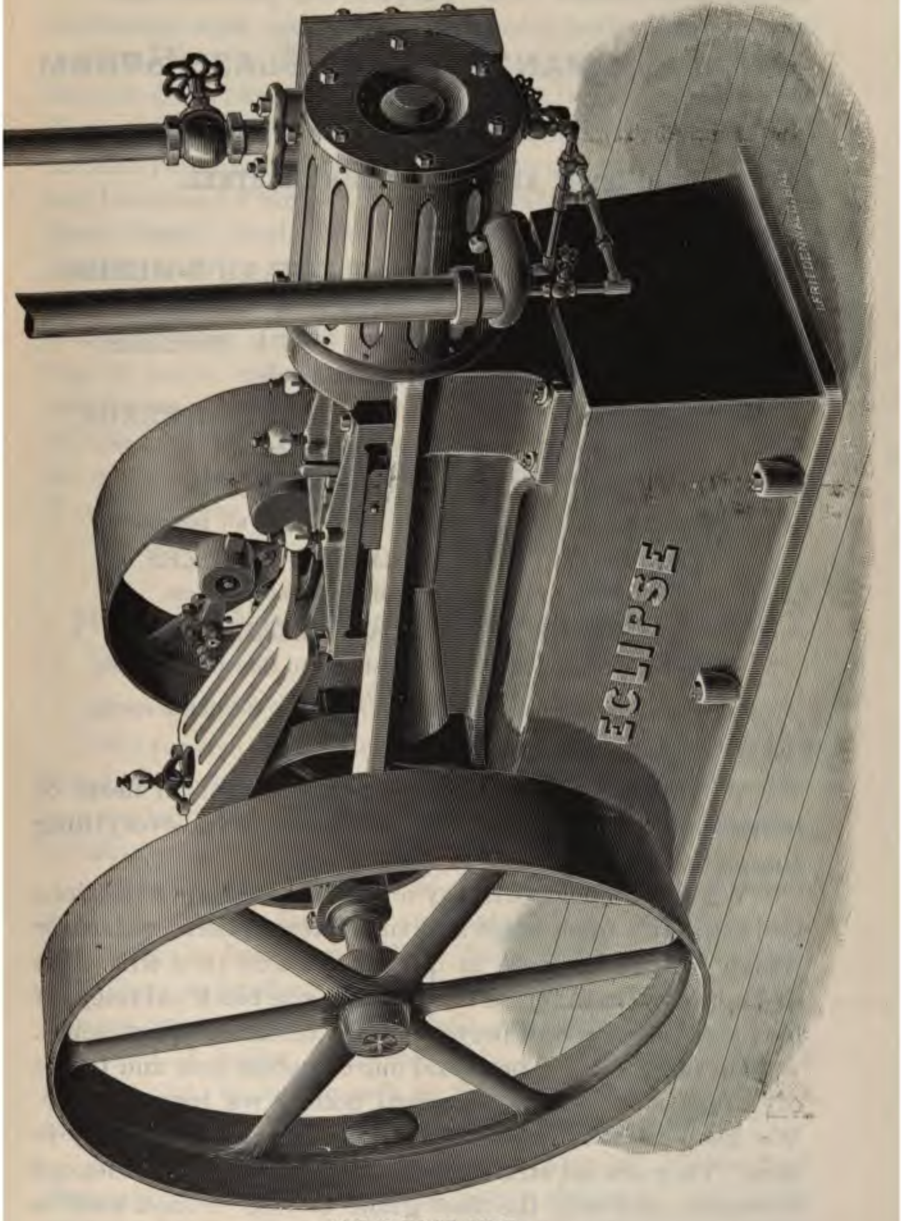
GOVERNOR SIDE.

Engraving of smaller Automatic Engines, made with or without high

Governor.

ECLIPSE AUTOMATIC ENGINE.

(PATENTED.)



FLY-WHEEL SIDE.

These Engines are fitted with high base, which allows the fly-wheels to clear the floor. Can supply both wheels same size, either large or small, or as per table, page 261.

FRICK COMPANY'S FIRST-CLASS STEAM BOILERS.

OF BEST AMERICAN IRON OR STEEL.

HORIZONTAL OR RETURN TUBULAR BOILERS,
For General Use, Mills, Factories, etc.
HORIZONTAL OR RETURN FLUE BOILERS,
For General Use, Saw Mills, etc.
HORIZONTAL OR PLAIN CYLINDER BOILERS,
For Iron Works, Sugar Plantations, etc.
LOCOMOTIVE OR FIRE-BOX BOILERS,
With Open Bottom and Water Front. For all purposes.
LOCOMOTIVE OR FIRE-BOX BOILERS,
With Water Front and Circulating Water Bottom.
UPRIGHT TUBULAR BOILERS,
Of Most Approved Designs, for Heating and General Purposes.

ANY OTHER APPROVED DESIGN RANGING FROM 3 TO 300-HORSE POWER.

We are prepared to furnish boilers set in nests or batteries, and independent or connected, with everything complete.

We solicit an opportunity to submit plans, specifications and estimates upon large and small steam plants, orders for which we can execute in quick time and in a first-class and approved manner. Plans for any size brick chimneys of best construction and proportion for certain requirements.

On page 267 will be found our complete lists and tables of dimensions of the standard boilers we manufacture. We keep at all times numbers of these boilers ready to ship. They are all strictly first-class, made by experienced workmen, and only the finer grade of iron or steel used in their construction. Each boiler is thoroughly tested before shipment, and fully warranted.

The following is a complete list of fixtures and fittings we furnish with each of our horizontal boilers, and all are understood to be included when we state that we furnish a BOILER COMPLETE: One Boiler Front (either arch or full flush pattern); Furnace Doors, with liners, registers and handles; Ash-pit Doors, with registers and handles; Smoke-box Doors and Frame; Grate Bars; Grate Bearers or Rests; Dead Plate; Arch Plate; Cleaning Doors and Frames; Binders or Brick Stays; Cast Washers; Anchor and Binder Bolts; Steam Gauge; Glass Water Gauge; Gauge Cocks; Water Column, Check Valve; Feed Valve; Blow-off Cock; Pop or Lever Safety Valve; Steam Stop Valve; Whistle, and Steam and Water Connections to connect fittings, or, in case of more than one boiler, to connect them, all ready for water, fire and steam. Injectors and their connections, if required, are always extra.

FRICK COMPANY'S STEAM BOILERS.

SPECIFICATIONS.

We furnish Horizontal Tubular Steam Boilers of any horse power required, diameter of shell, length, with best lap-welded tubes, of inches diameter and length as given in table, page 267.

Our Standard Horizontal Tubular Boiler has steam dome of suitable diameter and height, with steam nozzle, and flange in head, manhole in dome head, or top of shell of boiler, as preferred; all horizontal seams and dome flanges, where connected to shell, are double riveted.

Shell of boiler, dome and tube heads made of flange steel of 55 to 60,000 pounds to the square inch transverse strength.

All workmanship, bracing and staying of the best throughout; each boiler tested before shipment, and made tight under a hydrostatic pressure of 150 pounds per square inch. All work and proportions subject to approval of Hartford Boiler Insurance Company.

Each Horizontal Tubular Boiler is provided with a full ornamental flush front with fixtures and fittings (which comprises everything necessary for setting boiler, except mason work and materials therefor).

Each full flush front has two furnace doors with linings, two large swinging doors opposite front head with revolving damper in each, and two ash-pit doors with revolving damper in each, anchor bolts for front, all buck stays and buck stay bolts, lug plates and friction rollers, cleaning door with frame and anchor bolts, angle castings for back arch, dead plate, arch plate, grate bar bearers, and full set of grate bars for each furnace.

The fittings are first class and include: safety valve, steam stop valve, globe and check valve, steam gauge and combination column water gauge, gauge cocks and blow-off cock.

Also given feet of suitable smoke-stack of suitable diameter (made of heavy iron), with damper with guy rods and hood.

Detailed drawings to set boiler furnished free of charge.

We guarantee workmanship and materials of boilers made by us for one year.

HORIZONTAL TUBULAR BOILERS.

List and Table of Dimensions.

Horse Power at 15 square feet per H. P.	Heating Surface in square feet.	Diameter in inches.	Length in feet.	Flues. Number.	Flues. Diameter, inches.	Flues. Length in feet.	Thickness of Iron. Shell.	Thickness of Iron. Heads.	Dome. Diameter, inches.	Dome. Height, inches.	Diameter of Stack, inches.	Weight of Boiler.	Weight of Boiler Fixtures.	Weight of Boiler with Fixtures complete.
10	153	30	7	22	3	7	No. 4	$\frac{5}{16}$	18	16	14	1640	2660	4300
12	187	30	8	24	3	8	" 4	$\frac{5}{16}$	18	16	14	1870	2750	4620
15	227	32	9	26	3	9	$\frac{1}{4}$	$\frac{3}{8}$	18	16	15	2270	3000	5270
18	270	32	10	28	3	10	$\frac{1}{4}$	$\frac{3}{8}$	18	18	16	2410	3180	5590
20	302	34	10	32	3	10	$\frac{1}{4}$	$\frac{3}{8}$	20	17	18	2960	3400	6360
25	380	34	12	34	3	12	$\frac{1}{4}$	$\frac{3}{8}$	24	24	18	3500	3520	7020
30	450	36	12	40	3	12	$\frac{1}{4}$	$\frac{3}{8}$	24	30	20	4120	3940	8060
35	528	42	12	48	3	12	$\frac{9}{32}$	$\frac{3}{8}$	24	30	22	4860	4790	9650
40	600	46	12	54	3	12	$\frac{5}{16}$	$\frac{7}{16}$	30	30	23	5660	5240	10900
45	677	50	12	62	3	12	$\frac{5}{16}$	$\frac{7}{16}$	30	30	24	7260	5860	13120
50	760	54	12	70	3	12	$\frac{5}{16}$	$\frac{7}{16}$	30	30	25	8460	6670	15130
60	907	54	14	72	3	14	$\frac{5}{16}$	$\frac{7}{16}$	30	30	25	9580	6790	16370
70	1053	60	14	84	3	14	$\frac{11}{32}$	$\frac{7}{16}$	30	36	27	10820	7800	18620
80	1201	60	16	84	3	16	$\frac{11}{32}$	$\frac{7}{16}$	30	36	27	11970	7800	19770
90	1355	66	15	100	3	15	$\frac{3}{8}$	$\frac{7}{16}$	36	36	32	13850	8660	22510
100	1500	66	16	106	3	16	$\frac{3}{8}$	$\frac{7}{16}$	36	36	32	15940	8660	24600
112	1685	72	16	120	3	16	$\frac{7}{16}$	$\frac{1}{2}$	36	48	36	17400	14050	28450
126	1894	72	18	120	3	18	$\frac{7}{16}$	$\frac{1}{2}$	36	48	36	18940	14150	30090

List of Boilers with 3½ Inch Tubes.

Diameter in inches.	Length in feet.	No. of Tubes, 3½ diameter.	Square feet of Heating Surface.	Weight of Boiler, Front, Fixtures and Fittings.
36	12	19	272	8300
42	12	28	383	9800
46	12	30	414	11200
50	12	36	488	13400
54	12	42	562	14200
54	14	42	653	15500
60	14	52	796	18300
60	16	52	908	19900
66	15	66	1060	23000
66	16	66	1130	24000
72	16	86	1440	27800
72	18	86	1616	29300

List of Boilers with 4 Inch Tubes.

Diameter in inches.	Length in feet.	No. of Tubes, 4 diameter.	Square feet of Heating Surface.	Weight of Boiler, Front, Fixtures and Fittings.
36	12	16	264	8300
42	12	22	353	9800
46	12	25	398	11200
50	12	28	444	13400
54	12	28	452	14200
54	14	28	525	15500
60	14	40	716	18300
60	16	40	731	19900
66	15	52	970	23000
66	16	52	1033	24000
72	16	70	1352	27800
72	18	70	1517	29300

The above is our list of Standard Horizontal Tubular Boiler which we furnish with Fixtures as per pages 265–266.

FRICK COMPANY,

ENGINEERS,

WAYNESBORO, FRANKLIN COUNTY, PA.

MANUFACTURERS AND BUILDERS OF THE FOLLOWING :

MANUFACTURING DEPARTMENT:

- STATIONARY ENGINES, ALL SIZES,
- ELECTRIC AUTOMATIC ENGINES,
- STEAM BOILERS AND MOUNTINGS,
- FEED WATER HEATERS.

HEAVY MACHINERY DEPARTMENT:

- HORIZONTAL STATIONARY ENGINES,
  Slide Valve or Automatic.
- UPRIGHT ROLLING MILL ENGINES,
- CORLISS ENGINES,
  40 to 1000 H. P. in a Single Engine.
- ICE-MAKING AND REFRIGERATING MACHINERY,
- WROUGHT IRON AND STEEL FORGINGS,
- LARGE STEAM BOILERS AND TANKS.